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FILTH

IN ITS

RELATION TO DISEASE.

A REPORT

MADE TO THE

BOARD OF POLICE COMMISSIONERS.

OF THE

CITY OF CLEVELAND

BY

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HEALTH OFFICER.

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ERRATA.

On page 21, line 8, for " Varrentropp " read " Varrentrapp. "
On page 21, line 28, for " management " read " arrangements. "
On page 96, line 23, for " near where there " read "near the place at which."
On page 105, line 19, for " sewers " read " sewer. "

Report of the Health Officer.

To the Honorable Board of Police Commissioners:

Gentlemen:—As Cleveland has during the past Autumn and Winter been visited by an epidemic of diphtheria, which in its severity has seldom been equalled; and as the community is naturally interested in the cause and prevention not only of this dreaded scourge, but also in all other diseases, which by the majority of observers at the present day are deemed preventable, I respectfully beg leave to submit for your consideration the modern theory of the relation, which exists between what has been designated as "filth," and the affectious, which by its removal may be prevented.

Cleveland, O., December 31st, 1876.

CHAPTER I.

FILTH.

By the term "filth," sanitarians mean decomposing organic material, whether animal or vegetable, such as the contents of pig-sties, manure heaps, compost piles, privies, cesspools, sewers and drains, or as Dr. Simon says, "Such as eminently the presence of putrescent matter, solid or fluid, causing nuisance by its effluvia and soakage." The gaseous emanations from this decomposition in the presence of water and in the absence of light, particularly that which is always present in sewers, from which it derives its name, is known under the general name of sewer-gas.

It must be remembered that there are other causes which exert a deleterious influence upon health, such as overcrowding, poor ventilation, and improper food and clothing, which demand a separate consideration. It is better however, for the present purpose, to confine the term "filth" to "subject matter for sewers and scavenging."

To the "germ" theory of disease it is unnecessary for a report of this nature to refer, particularly as the nature of these germs is as yet but imperfectly understood: all that can be said of them is that in some way or another they seem to be associated with decomposition and unsanitary conditions. Neither would it be profitable to take cognizance of the discussion going on among pathologists of the present day as to the origin of disease. It is sufficient to recognize the fact, that the medico-scientific world is divided upon this subject into two classes;—one led by Liebig and supported by Virchow and the majority of the English observers, which claim that certain disorders, notably the zymotic diseases, spring spontaneously from filth; and hence, being *entirely* amenable to sanitary laws, have been designated by them "filth or preventable diseases:" the other, following Pasteur and upheld by Liebermeister, Pettenkofer and the greater portion of the German School, believe that filth does not

directly originate these affections, but simply increases a tendency to their causation, by furnishing a nidus or resting place, a favorable soil, in which the living organisms of disease multiply and develop, and without which they become as a rule inert and inoperative. In other words, the one class believe that filth *alone*, communicating the elements of decomposition, is sufficient to produce disease, while the other hold that there must be something more, viz: filth plus some particular poison. Pettenkofer, the warm supporter of the "germ" theory of disease, says that filth is like the charcoal in gunpowder. *It is necessary to have it, in order to produce the explosion.*

Practically these two theories are identical, since there is but little difference, whether filth directly causes disease, or is an essential factor in the development of the peculiar organisms which produce disease.

That unsanitary conditions bear a certain relation to a particular class of affections, is now the opinion of the majority of the medical profession. There never has been a time, when physicians were more assured upon this point; for although it must be confessed that such eminent men as Stokes and Graves are firm in their belief that unsanitary surroundings have nothing to do with the causation of disease, yet most assuredly the statistics of mortality would seem to point to an entirely different conclusion. At the present day we never witness such wide spread and fatal epidemics as occurred in past centuries; we never have to record, in civilized countries, such fearful destruction as visited Basle in the 14th century, when forty-one thousand deaths occurred in one epidemic of the Plague—a disease which, at about the same time, carried off three-quarters of the entire population of Venice. This change is due in a great measure to a better understanding of sanitary laws, and to their enforcement. But these laws are by no means perfectly understood as yet, since the rate of mortality from the preventable diseases in all sections of the world, in spite of sanitary reform, is even at the present day very high. Even war has not claimed as many victims as have fallen by our disregard of the elements of hygiene. England in *twenty-two* years of continuous war lost 79,700 lives; in one year of cholera she lost 144,860. In Great Britain the deaths occuring in 1842 from typhoid fever alone, a preventable disease, outnumbered the loss sustained by the allied armies at the battle of Waterloo!

Dr. Simon, in one of his reports to the Privy Council of Great Britian, says, that the annual deaths in England are fully 125,000 more numerous than

they would be, if the existing knowledge of the chief causes of disease, as affecting masses of population, were reasonably well applied; that of each one hundred persons who die, not quite ten have reached the age of seventy-five, and that of every one hundred children born, hardly seventy-four complete five years of age. This is in England, whose sanitary system is the best in the world, and whose health ordinances are more rigidly enforced. We cannot of course forget her dense masses of population, crowded together within narrow limits; but in spite of all this the death rate of London (on an average only 21.4 per 1000) is low, when compared to those of New York and Boston, which are 29.08 and 24.62 respectively.

In Massachusetts, which is generally considered a healthy State, during the five years from 1869 to 1873 inclusive, the deaths from the zymotic diseases represented 26 per cent. of the entire mortality; and reckoning, as I think we may in some measure at least, consumption and other pulmonary disorders, the deaths from all preventable causes represented the enormous proportion of one-half the entire mortality!

England and Scotland together gave in the five years ending January 1st, 1870, deaths from zymotic diseases,—diseases which are mainly preventable, amounting to 21.9 per cent. of the total mortality, as shown in the returns made to Parliament in 1871. In the vital statistics of New York, for the past eleven years, zymotic diseases are charged with about 32 per cent. of the deaths from all causes.

From the imperfect statistics, which have been gathered in this country, it is safe to conclude that the zymotic diseases cause about one-half the total number of deaths, which occur annually in our large cities.

The following table shows the ratio of deaths from zymotic causes to the total yearly mortality:

Pittsburgh,	35 per cent.
Chicago,	34 "
Brooklyn,	33 "
Boston,	33 "
Cincinnati,	33 "
Milwaukee,	31 "
Baltimore,	28 "
Washington,	25 "
Philadelphia,	20 "
San Francisco,	22 "

In Cleveland, whose death rate is exceptionally low when compared to other cities, the deaths from preventable diseases during the year 1876 amounted to 32.96 per cent. of the total number.

These statistics, it must be remembered, represent only the actual *deaths*, but can furnish no adequate estimate of the incalculable amount of sickness, (which Dr. Playfair places at twenty-eight for every death, with a loss of fifty dollars for each case of sickness); the impairment of health, both temporary and permanent; the physical suffering; the pauperism, and hence the increased tax upon the State; and finally the transmission of an enfeebled constitution to posterity, which these statistics can only suggest to our imagination.

Evident as is the influence, which filth exists over the causation of certain diseases, just as clear is the fact, that sanitary improvements have lowered the death rate and improved the physical and moral condition of individuals and communities.

In London, one of the cleanest of large cities the death rate is one-third lower than in Munich and Berlin, the filthiest of German cities. In Hamburg and Dantzic, the only German cities, Dr. Fulsom says, where systematic sewerage works have been completed for several years, the increased cleanliness has reduced the mortality in a great degree.

In England the records of vital statistics have reduced this connection between filth and disease to a certainty.

In the Ninth Report of the Privy Council of Great Britain, Dr. Buchanan has shown that in twenty-five cities and towns, with an aggregate of 593,736 inhabitants, sanitary improvements reduced the death rate 27.68 per cent., "while the improvement made in the inhabitants in cleanliness, self-respect and decency has been as striking, as the improvement in health!"

The following table shows the decrease in the death rate of twenty-four English cities and towns by proper drainage, sewerage and water supply:

Name of City or Town.	Decrease (−) or Increase (+) per cent. of Annual Death-rate.	Decrease (−) or Increase (+) per cent. of Death-rate from Typhoid Fever.	Decrease (−) or Increase (+) per cent. of Death-rate from Pulmonary Consumption.	Name of City or Town.	Decrease (−) or Increase (+) per cent. of Death-rate from all causes.	Decrease (−) or Increase (+) per cent. of Death-rate from Typhoid Fever.	Decrease (−) or Increase (+) per cent. of Death-rate from Pulmonary Consumption.
Bristol,	−1½	−33	−22	Penzance,	0	+ 6	− 5
Leicester,	−4½	−48	−32	Salisbury,	−22	−75	−49
Merthyr,	−18	−60	−11	Chelmsford,	+10	+ 5	0
Cheltenham,	−4½	−37	−26	Ely,	−14	−56	−47
Cardiff,	−32	−40	−17	Rugby,	−2½	−10	−43
Croydon,	−20	−63	−17	Penrith,	0	−55	− 5
Carlisle,	− 8	− 2	+10	Stratford,	− 7	−67	− 1
Macclesfield,	−20	−48	−31	Alnwick,	− 6	−36	+20
Newport,	−32	−36	−32	Brynmaur,	−15	−56	+ 6
Dover,	− 7	−36	−20	Worthing,	0	+23	−36
Warwick,	−7½	−52	−19	Morpeth,	− 6	−40	− 8
Danbury,	−12½	−48	−41	Ashby,	− 9	−56	+19

The death-rate among infants, and from measles, scarlet fever and whooping cough, has been reduced very considerably, but in about the same proportion as the total from all causes. The decrease in the prevalence of typhoid fever has been very notable. The death-rate from consumption had decreased in a marked degree, and, generally speaking, *in proportion as drying of the soil had been accomplished by the sewers.*

Two hundred years ago the death-rate in London was 80 per cent., but owing to the improvement in sanitary laws, it has been reduced to 21½ per 1000, "in spite of the great growth of towns, and the great crowding of the population."

Twenty-five years since, the death-rate in certain quarters of London was so much reduced by the improved method of sewerage introduced, that it was

reckoned, that in the same ratio there would be 25,000 less deaths in London alone, and in England and Wales, the average age of deaths would be 48 instead of 29.

The following table shows the reduction in the death-rate per 1000 in fourteen American cities from 1866 to 1875:

CITIES.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.
New York,	33.5									29.39
Philadelphia,	24.3									22.24
Brooklyn,	27.8									24.92
St. Louis,	46.3									14.46
Chicago,	32.2									18.80
Baltimore,		24.4								20.90
Boston,	22.8								20.8	
Cincinnati,	34.9								20.5	
New Orleans,		54.3								29.13
San Francisco,	21.0									18.1
Providence,										19.02
New Haven,	19.5									20.48
Pittsburgh,							27.3			21.12
Cleveland,						19.5				18.28

With these statistics before us to prove the necessity for sanitary reform, in order that our death rate, already low, may be still further decreased, the natural inquiry arises, what diseases exist which by this reform may be prevented. There is one large class, viz: the Zymotic or Infectious Disease most of which, if not all, seemingly bear such an intimate relation to filth, that they are, by most observers at the present day, termed Filth or Preventable Diseases. Liebermeister thus speaks of them: "It is supposable that there exist certain low organisms, which usually vegetate and propagate themselves outside the human system in the decompostion of organic matters, or in plants and animals, but which, under special conditions, become planted in man—find there a favorable soil for their development, and may then represent the

specific cause of an infection, which for a long time has been transmitted from man to man."

Of this class, those which may be designated as diarrhœal, stand out pre-eminently in their close and intimate relations to uncleanliness. Dr. Simon says: "The mucous membrane of the intestinal canal seems peculiarly to bear the stress of all accidental putridities which enter the blood; whether they have been breathed, or drunk, or eaten, or sucked up into the blood vessels from the surface of foul sores, or directly injected into blood vessels by the physiological experimenter, there peculiarly the effect may be looked for; just as wine, however administered, would 'get into the head,' so the septic ferment, whencesoever it may have entered the blood, is apt to find its way thence to the bowels and there, as an universal result, to produce diarrhœa."

The common diarrhœal disorders, which annually in all large cities carry off such a large proportion of the infantile population,* demand but a passing notice, since all are agreed that unsanitary surroundings add largely to their increase. Lebert says that cholera morbus stands in direct connection with the products of decomposition. In proof of this, he relates the following case, quoted from Searle, of England: "An alley filled with mud and refuse had been cleaned out, and the exhalations from it during this process had been wafted over a neighboring yard attached to a school, from which twenty out of the thirty scholars were attacked with cholera morbus." "Autumnal diarrhœa," says Wilson, "is more likely to prevail in badly sewered districts." Carpenter mentions a case of violent attacks of diarrhœa, prostrating the inmates of Christ Church Workhouse, in Spitalfields, whenever the wind blew from the direction of some Manure Works. When the factory was closed, no more cases of diarrhœa occurred.

No doubt can exist that cholera may be spread, and very largely too, by the impregnation of water, by cholera discharges, thrown into privies and cesspools, and leaching through the soil, especially if it is a porous one; or from the admission into the houses of sewer gases from drains containing such discharges. An outbreak of cholera occurred in the London Workhouse, in 1866, in consequence, it was thought, of a sudden efflux of sewer air from a

* In Cleveland, the deaths from diarrhœal disorders during the year 1876, *exclusive* of typhoid fever, amounted to 10.75 per cent. of the entire mortality—*inclusive* of typhoid fever, 12.89 per cent.

drain containing choleraic evacuations. Pettenkofer affirms that great humidity of the soil, and accumulations of ground-water in the superficial layers, exert a powerful influence over the diffusion of the disease, "and it is because of the ease with which sewer fluids filter through the soil, that cellar habitations are especially frequently visited in cholera epidemics." (Lebert.)

In the cholera epidemic of 1866, in London, the mortality in the east end, which was supplied with water from a reservoir, "which was little better than an open excrement and sewer receptacle," was 63 to 111 in 10,000; while, in other portions of London, which were supplied with pure water, the mortality was only 2 to 12 in 10,000.

In Breslau, a privy vault leaked, which allowed the privy filth to leak through the soil and impregnate the water from a well, from the drinking of which twelve persons, in one house, died of cholera in 1867, and many others were attacked and died.

Typhoid Fever.—This disease, standing as it does as the great type of enteric disorders, and as the representative of the so-called Filth Diseases, demands a more extensive notice, particularly as it is an affection which is prevalent all over the world, and from which so many persons have lost their lives. Whether we look upon this disease, with the majority of physicians, as springing spontaneously from unsanitary conditions, or accept the theory of Budd and Liebermeister, that the contagion of the affection is taken into the system from the typhoidal excreta which have not been removed by proper hygienic measures, the broad fact remains, that typhoid fever is intimately associated with neglect of sanitary laws.

Murchison, in his celebrated work on "Continued Fevers," says: "It is far more probable that the poison is *always* the result of decomposition. If the disease can be traced to impurities, in a few undoubted instances, it is reasonable to infer that its causes are similar in all cases where it has a spontaneous origin. In most instances, the poison appeared to be contained in the volatile emanations from drains, cesspools, etc.; but in other cases, it is probably taken into the system through the medium of the drinking water."

Liebermeister says: "The poison of typhoid fever does not *originate* in decomposing substances, but finds in them a favorable ground for its growth

and multiplication." Again, he says: "The infection can be produced by the air we breathe, and by the water we drink—the infection being produced by the inhalation of the exhalations from privies, sewers, wells, etc."

Dr. Anstie, in his "Notes on Epidemics," says: "In short, all observers arrived at the conclusion that it would be possible, by rendering our drinking water absolutely pure, and by disinfecting our sewers at the earliest moment, to entirely, or almost entirely, to suppress typhoid fever."

Dr. Austin Flint says: "Its special cause may be a product of the decomposition of human excrement."

Both Dr. Roberts and Dr. Aitken regard it as a disease caused by polluted drinking water and defective drainage.

In an exhaustive report on the "Causes of Typhoid Fever in Massachusetts," by the late Dr. George Derby,* the following were the conclusions arrived at: "The single continuous thread of probability, which we have been able to follow in this inquiry, leads uniformly to the *decomposition of organized substances* (and chiefly vegetable) as the cause of typhoid fever in Massachusetts."

"Whether the vehicle be drinking water, made foul by human excrement, sink drains, or soiled clothing; or air made foul in enclosed places by drains, decaying vegetables, or fish, or old timber, or in open places by pig-sties, drained ponds or reservoirs, stagnant water, accumulations of filth of every sort, the one thing present in all these circumstances is *decomposition*."

"So firm," says an eminent physician, (referring to exhalations from foul drains, cellars, privies and pig-sties,) "is my belief in the filth origin of typhoid fever, that, when I meet with a case of this disease not readily traceable to some of these causes, I infer that the the truth has not been told me, or that my perceptive powers have been at fault."

Dr. Simon, the distinguished Medical Officer to the Privy Council of Great Britain, and very eminent as a sanitarian, says: "The experience is not only that privies and privy drainage, with their respective soakings and pollution of air and water which are thus produced, have, in innumerable instances, been the apparent cause of outbreaks of typhoid fever, but further, that they have seemed capable of doing this mischief in a doubly destructive way."

* Report of the State Board of Health of Massachusetts, for 1871.

The most striking example of the relation between filth and typhoid fever occurred some years ago in the Maplewood Young Ladies' School in Pittsfield, Mass. Out of seventy-four resident pupils, fifty-one had well-marked typhoid fever, and sixteen died; while sixty-six, or nearly ninety per cent., had sickness of some sort. The Seminary building had behind it a foul barn-yard, the cellar was used for storing vegetables, and its privy closets were connected with the main hall. The connection between these conditions and the epidemic could not be questioned.

In the autumn of 1858, an epidemic of typhoid fever broke out in the neighborhood of Windsor Castle in England, in which, during the last four months of the year, one-twentieth of the whole population were attacked. Most of the cases were confined to two or three districts which had a complete system of drainage, and the drains were flushed partly from a continuous flow of water from the Thames, and partly from artificial tanks. In consequence of a long-continued drought, however, the river had fallen greatly in its level, and the tanks had been allowed to get dry. "The result," says Murchison, "was that the sewage collected in the sewers, *and in consequence of their ventilation being very imperfect*, the sewer gases escaped directly into the houses."

In the autumn of 1857, typhoid fever broke out in Fleet Lane, in London, during the construction of a new sewer. Soon after the old sewer was opened, diarrhœa commenced to appear, and typhoid fever soon followed. During all this time, from June to October, the inhabitants complained of an offensive smell.

In August, 1829, twenty out of twenty-two boys, attending school in Clapham, were attacked with severe intestinal disorders, characterized by high fever, vomiting and purging, within three hours after watching some workmen clean out an offensive drain.

In Winterton, in Lincolnshire, typhoid fever attacked one hundred out of one hundred and forty-five, living in a certain portion of the town. The commission, appointed to examine into the causes, reported that this serious outbreak was due to the state of the privies, cesspools and wells.

In December, 1835, typhoid fever broke out in a boys' school in Pittsfield, Mass., from which the principal and four boys died. It was discovered that the drinking water was derived from a well, under the wash-room, which had

become polluted by a defect in the wash-room drain. Just as soon as the well was discontinued, the disease subsided.

A severe case of this disease occurred in Nantucket, Mass., which seemed to be due to decaying turnips in the cellar of the house in which the disease occurred. This case is instructive, since it is the custom with some persons to store away vegetables in the cellars of their dwellings for winter use, a custom which is free from danger as long as the vegetables keep from decay. Just as soon, however, as decomposition commences, they are prejudicial to health.

Dr. Flint mentions an outbreak of typhoid fever which occurred in a village in Western New York, in 1849, during which twenty-eight out of forty-three persons comprising the community were attacked. All those who contracted the disease drew their drinking water from one well attached to a tavern, which had undoubtedly been polluted by the discharges of a gentleman, who, in traveling from a neighboring State, had been attacked with typhoid fever, and in consequence had been obliged to remain at this hotel. One family, however, who lived in the infected district, owing to a feud with the tavern keeper, did not use this well water, and consequently escaped. The tavern keeper was accused of poisoning the well, but obtained damages for the slander.

In connection with this case, Dr. Flint remarks: "In typhoid fever, the contagion is in the dejections, and this fever may be, and generally is, caused by a morbific matter produced in decomposing excrement." He says that the spontaneous origin of this disease is to be avoided by a complete precaution against the pollution of water or air by dejecta from healthy persons.

In 1874, ten Oxford students went into Cornwall to spend their vacation. The place had been recommended on account of its supposed healthy condition, but the water and soil were found so polluted, that six out of the ten were attacked in consequence with typhoid fever.

Many persons have suffered, during the past summer and autumn, from enteric disorders, especially typhoid fever, after a visit to the Centennial Exhibition. Although there were many causes which co-operated to bring about this result, yet it cannot be doubted that the wretchedly defective drainage of the grounds must be assigned as the chief element at work in the production of the disorder.*

* Ten thousand persons have been known to have lost their lives from this supposed cause.

A few years since, a very severe epidemic of typhoid fever broke out among the summer visitors of a leading hotel in Mt. Desert Island, on the coast of Maine, from which several died. The undoubted cause was the fact that the kitchen and house slops were discharged upon the ground, by a drain which terminated but a few rods from the house.

It would be well for us to study closely this list of examples, which, though long, is short in comparison to the many similar cases which have been reported. Even if our community is free from any such epidemic to-day, it does not follow that it will always be fortunate enough to escape such a disaster, which, when it does come upon us, will be, in my estimation, very fatal, as long as wells are so extensively used to supply the drinking water.

Diphtheria.—This is another disease belonging to the same class as typhoid fever, and one which for us possesses a peculiar interest, on account of the extent to which it has prevailed in Cleveland during the last two years. In 1875, the deaths from diphtheria, in this city, amounted to 243, or 8.20 per cent. of the whole number; in 1876, 395, or 12.30 per cent., which is a fatality demanding a rigid investigation to discover whether any cause has existed for it, and if so, whether it can be removed.

As this is one of the zymotic diseases, the same remark applies to it as to typhoid fever, viz: that at the present day it is believed either to arise *de novo* from filth, or in filth its special poison finds a favorable place for its development.

In an animated discussion which took place, a few years since, at a meeting of the Pathological Society of London, in which the most eminent men of the Kingdom took part, it was decided, not however without a warm debate, that diphtheria was essentially a filth disease, and was caused, whenever it had a spontaneous origin, by the conditions which have already been mentioned as defining the term filth.

Although it must be admitted that the exact nature of the etiology of this disease has not as yet been exactly determined, yet proofs are accumulating every day, which render it more than probable that it stands in a definite relation to uncleanliness. The whole literature of the subject, particularly in the English language, is full of facts in support of the theory that it depends upon certain local and atmospheric causes. As was stated in a previous report

which I had the honor to present to your body, Dr. Ross said, in speaking of diphtheria at a late meeting of the British Medical Association, that not density, but dirt had to be guarded against, and defects of construction, particularly the defects arising from bad foundations. Dr. Johnson believes that "diphtheria in all its forms and varieties is, as certainly as typhoid, a disease of filth origin." Sanderson says: "It is not possible to avoid the conclusion, that it is due to local causes, and would have been prevented, in particular instances, if the nuisances had been abated."

To a series of letters which I addressed, in the early portion of the winter, to the leading physicians of Boston, New York and Philadelphia, asking their opinion of the cause of this affection, almost unanimous answers have been received, confirmatory of the theory that, in some manner, it was associated with unsanitary conditions.

Prof. P. A. Penrose, of the University of Pennsylvania, believes that diphtheria is caused by foul air. "Drainage," he says, "is here a factor." He lays the greatest stress upon illy-ventilated living and sleeping rooms as causes, and writes that he has never seen a case of diphtheria in *thoroughly* ventilated houses.

Dr. John T. Metcalfe, Professor Emeritus of Clinical Medicine in the College of Physicians of New York, says that, although he does not consider diphtheria can be developed by *ordinary* uncleanliness, still it had surely been worse in the *badly-drained* and over-crowded parts of New York, when it had existed as an epidemic.

Prof. Alonzo Clarke, of the same College, says that the disease has prevailed mostly in the crowded population of New York, "where, with other sanitary badnesses, the sewerage is imperfect, or does not reach the dwellings, pit privies being used instead of water closets."

Dr. Francis Minot, Professor of the Theory and Practice of Medicine in the Harvard Medical School, says: "Diphtheria has always been most prevalent in Boston in those localities whose sanitary condition was bad, particularly in respect to drainage, ventilation and cleanliness. It has been observed, that both the number of cases and fatality were greatest in the *lower stories* of tenement houses, in which the disease prevailed; and that its extent and severity diminished in proportion to the height above the ground of the lodging rooms.

"While recognizing the fact," he writes, "that it occasionally is met with in what are considered healthy localities, I consider diphtheria to be a filth disease." In conclusion, he says: "I believe that these views are abundantly borne out by evidence given in the various Annual Reports of the State Board of Health of Massachusetts, as well as elsewhere."

The following letter from F. W. Draper, M. D., Registrar of Vital Statistics for the State of Massachusetts, and Medical Inspector for the City of Boston, is so instructive that I beg leave to append it:

BOSTON, 36 Worcester Street, December 2d, 1876.

DR. F. WELLS, Health Officer:

Dear Doctor—In reply to your note of November 26th, conveying an inquiry concerning the etiology of diphtheria in Boston, I beg to say that the disease has assuredly prevailed most extensively, and its type has been most severe, in localities of well-marked unhealthful characters as to drainage and filth. Our service of drinking water cannot be included among the probable causes of the disease, inasmuch as the use of Cochituate water is nearly universal, and our supply is almost above reproach with regard to its purity and its liability to contamination.

I am not yet convinced that diphtheria should be classed as a "filth-disease," as we class typhoid fever and cholera. In view of its distinctly contagious character, I think it occupies a middle ground between the typical contagious diseases (small pox, scarlatina,) and the typical "filth-diseases (typhoid); unquestionably filth fosters a predisposition, and once the poison is generated, supplies its nutriment; but that filth generates the poison of diphtheria, I consider not yet demonstrated. Practically, however, it comes to the same end; and I would say to any community, large or small, family or metropolis, in so far as you depart from a standard of cleanliness—clean air, clean water, good food, proper clothing—you tempt the inroads of infectious diseases, diphtheria included; and the more filthy you are, the more fatal and far-reaching will be the invasion. Especially do I believe this to be true with regard to drainage and sewerage, as peculiarly to be looked after because of their essential aid in promoting public cleanliness and public health, if they are well managed; and contrariwise, because of their distinctive liability to get out of order, and so to create the nuisance they were intended to abate.

Yours very truly, F. W. DRAPER.

Prof. C. E. Buckingham, of the Harvard Medical School, believes decidedly in the filth origin of this disease.

Dr. William Pepper, Professor of Clinical Medicine in the University of Pennsylvania, and one of the authors of a celebrated work on the Diseases of

Children, says that he cannot regard this disease as purely a filth disease. He writes as follows:

"I have, however, of late been more strongly convinced that bad drainage, foul sewers, tainted water supply, etc., do more than exert merely a depressing influence in diphtheria, as they do in many other diseases. It seems to me that they determine a special virulence and fatality in the disease itself, and moreover, such an influence on the system as to render it more susceptible to the disease. My impression is, that diphtheria, when prevalent in a locality, does therefore specially affect those parts where the hygiene conditions are bad."

Dr. C. A. Budd, Emeritus Professor of Obstetrics and Diseases of Women and Children in the University of the City of New York, considers it as essentially a filth disease. and caused by unsanitary conditions.

Dr. A. L. Loomis, Professor of Pathology and Practice of Medicine in the same University, says that most of the cases which have occurred in New York, have been in localities "where the sanitary conditions are bad."

Dr. Henry Hartshorne, formerly Lecturer on Hygiene in the University of Pennsylvania, writes, that although he cannot regard diphtheria as *exclusively* a filth disease, yet he has seen abundant proof 'that *filthy air* and unsanitary local conditions will increase its extension and fatality."

Dr. T. G. Thomas, Professor of Obstetrics and Diseases of Women and Children in the College of Physicians and Surgeons of New York, and widely known as an eminent practitioner, looks upon "filth, *sewer gas*, a low dew point and bad ventilation as the elements upon which diphtheria feeds and flourishes; but the germs of the disease, being once made active, may invade any locality."

Dr. W. T. Lusk, Professor in the Bellevue Medical College, writes: "I have no question that diphtheria is a filth disease. Sometimes the connection between bad drainage and the malady has proved, in my practice, very intimate."

The following interesting letter from Dr. J. L. Smith, Lecturer on Children's Diseases in Bellevue Medical College, a gentleman who has had exceptional advantages in studying these disorders, and widely known as the author of a standard work on Diseases of Children, is very instructive:

NEW YORK, 227 West Forty-ninth Street, Dec. 2d, 1876.

Dear Sir—There can, I think, be no doubt that diphtheria often originates, *de novo*, from unsanitary conditions. It has always been most prevalent and fatal, in New York, in the

poor quarters, where such conditions most abound, especially uncleanliness, and privy and sewer gases.

But diphtheria is highly contagious through the breath, or by personal contact, and therefore those children of the poor who are mildly affected by it, but who go about the streets or to the schools, often communicate it to the children of the better classes, who live in apartments that are clean and free from noxious gases, and who live, or endeavor to live, in strict conformity with the laws of health.

Yours truly, J. LEWIS SMITH, M. D.

Dr. Ashhurst, a Member of the Philadelphia Board of Health, replied, that in his individual opinion as a member of the Board, epidemic diphtheria and epidemic scarlatina were intimately associated with defective drainage.

Oertel, a late German writer upon diphtheria, although he affirms generally that this disease has no local origin, yet says that at times *the influence of such local conditions* appears to be *especially marked.* He further remarks, that all influences, which are likely to prejudice the health in general, seem in contradistinction to what has been previously said, to exert a more definite influence in occasioning an outbreak of diphtheria and favoring its spread. "The development of a zymotic disease," he says, "is particularly favored by poverty and *uncleanliness;* and when diphtheria first invades the hovels of the poor, where the air is impregnated with animal emanations, where men and animals are crowded together under the same roof, and dung-heaps, *privies* and other sources of animal putrefaction fill the air with their effluvia, it only follows the general law."

Diphtheria he considers a miasmatic disease, which develops very rapidly under the influence of poisonous miasms.

This same author speaks of an epidemic of diphtheria, which, some years since, passed through the marshy lands of Essex and Yorkshire, in England, and thence across Devon and Cornwall to the Thames' banks, invaded North Wales, and ended in the Cornish Mines.

By a reference to the Appendix to the Report of the Medical Officer to the Privy Council, for 1874, much can be learned of the outrageously unsanitary condition of these localities. These are but examples of the whole:

"Barking (Essex): 'Unwholesome water; system of drainage and sewerage imperfect; passage of sewer air into the houses.'

"Doncaster (Yorkshire): 'Polluted water; bad means of excrement disposal; escape of sewer air into dwellings.'

"St. Just (Cornwall): 'Almost universal foulness of soil and air about houses; scanty and impure water supply.'"

Germany has been visited by several epidemics of diphtheria, and in 1868 it broke out in Berlin. But, until the last ten years, Hamburg has been the only German city which has had a sewerage system; "all the other cities were more or less filthy," Berlin particularly. Varrentropp, a distinguished German scientist, remarked, in 1868, that it was "offensive to both eyes and nose to enter the majority of German houses in the warm weather."

Holland has also suffered severely from this disease. But Holland is a country of canals, into which, in the large cities at least, common privies discharge by straight tubes, and into which the lower orders throw the house refuse. On this account, it is impossible to get a pure supply of drinking water, except in limited amounts.

An epidemic of this disease broke out, a few years since, in New England, which for severity has seldom been equalled. It commenced in Vermont, in the valley of the Deerfield river, and almost simultaneously in Adams, Mass. From these two points it traveled down the valley, attacking with unusual severity the towns of Florida, Heath, Coleraine, Greenfield, Leyden and Conway. It then spread along the western bank of the Connecticut river, "visiting West Springfield and Holyoke with some severity." On the east bank, Amherst suffered notably.

The sanitary condition of most, if not all these towns is bad.

Of Amherst, the sanitary reporter says: "The town is indeed beautiful for situation, but can never hope to attain cleanliness until it ceases to drink in impurities from its long-used wells, and, by some system of sewerage, washes out the filth from its midst."

Of Florida, it is said: "The hygienic management of our mountain towns are nearly all the same, and with little prospect of improving them."

In Conway, whose sanitary condition, according to the Secretary of the State Board of Health of Massachusetts, is bad, the disease "assumed a terribly malignant form in the immediate vicinity of decaying animal matter—first,

near a slaughter-house; second, near the field where the offal was thrown; and third, close to the shed for rendering tallow."

These are but types of the usual reports from these towns.

The conclusions to which the Board of Health of that State came were, that bad drainage and a saturated soil often seemed the chief causes of the disease in Massachusetts, "while generally bad hygienic surroundings have been the apparent indication for unusual severity in the attacks."

In the year 1875, the causes of diphtheria were made an especial study by the above Board, with the following conclusions:

Exposure to cold and damp is given as at least an important predisposing cause. "In this connection," the report says, "it is proper to speak of the privies of many of our public schools and dwelling houses in terms of the strongest reprobation."

"*Bad drainage* is thought, by most of our correspondents, to be associated with diphtheria in the immense majority of cases, or that its greatest severity is reached in badly-drained localities.

"Filth, although not so generally connected with diphtheria as with typhoid fever, diarrhœa and dysentery, plays an important part in its causation, especially when associated with dampness. In some of the towns, the contamination of drinking-water with filth has appeared to be at least partially at fault; in a few cases, the evidence is quite strong as to its being, if no more, a cause of unusual severity in symptoms, or of more extended prevalence.

"Many facts and suggestions are given as to the predisposing causes of diphtheria, its prevalence, etc. In our State at least, this disease, as well as typhoid fever, is very often found associated with bad drainage, and has thus far been of greatest severity in rural districts, where there are no sewers and no proper drainage of the soil.

"One fact is impressed on us with great force, that the disease is primarily connected with decidedly unsanitary conditions; but that, after a certain degree of concentration of the poison has been reached among those living under bad hygienic circumstances, the best attention to sanitary law will not in all cases protect the more fortunate part of the community who reside in the best parts of towns and cities.

"*The disease has been, for the most part, one of the unsewered towns; in the cities where there are sewers, it has been most prevalent;* or entirely so, in those parts which are *badly drained or have no sewers.*

"1. That diphtheria is contagious, and may be, under certain circumstances, highly so.

"2. That it is also infectious, although not to so great a degree as scarlet fever, measles and small pox.

"3. That, where other circumstances assist, its spread is promoted by *dampness or moisture of soil, whether naturally existing or produced, especially with a tough, impervious subsoil.*

"4. That the *special* connection between this disease and filth is not so clearly made out, although such a condition would undoubtedly aggravate the bad effects of moisture alone. The subjects of contamination of well-water by human filth, and the air of sleeping-rooms by sewer gases, as predisposing causes of the disease, deserve more careful study in the future; our returns do not at present give us sufficient data for the expression of a *positive* opinion.

"5. That exposure to dampness and cold, especially among children and those otherwise predisposed to the disease, tends to induce diphtheria.

"6. That individual or family proclivity, age and depression of the vital powers from any cause whatever, are important factors in inducing this disease as well as others more rapidly, and in a more fatal form, when other causes are also in some degree present.

"7. That there is also some atmospheric condition, of which little is now known, the presence of which, even if not necessary, is at least important in the causation of diphtheria."

The "New York Medical Record," in one of its issues, says: "Diphtheria may be due to the foul emanations from slaughter-houses, or it may arise from some accident or neglect in one's own dwelling, where it was supposed that every sanitary regulation was enforced. * * * There seems to be no reason why such influences as those described should not, in many cases, be causes of diphtheria, just as they often produce typhoid fever, puerperal fever and cyrsipelas—an opinion that is beginning to be very generally felt."

Whenever diphtheria has occurred in Cleveland as an epidemic, it has prevailed more severely upon the west and south sides of the river. During

the epidemic of 1876, three of the prominent physicians upon the east side treated less than fifty cases altogether; while three of the leading physicians, who practice principally upon the west and south sides, treated nearly three hundred cases!

This great difference, I cannot but think, is due, in a great measure, to the lack of sewerage in that part of the city, which not only permits the contamination of the well water, which is so largely used, but also pollution of the air by the decomposition of organic matter, which, on account of the want of sufficient sewerage, cannot be rapidly carried off. Another cause must also be found, in the light of what has already been said, in the soil-dampness which exists in many sections upon the other side of the river, produced by a total lack of subsoil drainage. In many portions it is impossible to dig a post-hole without meeting with water; and it is precisely in these localities that by far the largest number of cases of diphtheria have occurred.

In September, 1876, an epidemic of diphtheria, attacking twelve persons, broke out in the Atwater Block. Upon an examination being made, a broken box-drain was found under the building, from which sewerage matters had escaped. The drain was repaired, and no new cases occurred.

In Unionville, Ohio, diphtheria has prevailed several times as an epidemic, but it invariably commences in the low, flat portions of the town, where the sanitary condition is bad, and subsequently finds its way to the higher portions.

A few years ago, diphtheria made its appearance in a small town near Warren, Ohio, from which eighty-eight from eighty-nine children between certain ages, died. The town was situated upon low, damp ground, upon the borders of a river, and consequently its sanitary condition was bad.

Four or five years since, a number of cases of typhoid fever and diphtheria occurred in that portion of Euclid avenue lying between Erie street and the Square. The drainage, however, was so imperfect that a new sewer was afterwards constructed, and no cases of these diseases have occurred there since.

Besides the diarrhœal disorders and diphtheria, there are other disorders which are, at the present day, believed to be more or less associated with unsanitary condition; or, at least, it has become a pertinent inquiry among physicians, whether filth does not in some way operate to cause them.

Among these diseases is erysipelas, of which Volkmann relates the following case: "Two patients, occupying adjoining beds in Middlesex Hospital, were constantly attacked by erysipelas. A rigid examination into the cause, disclosed the fact that a privy-pipe, which was situated in the wall, had been broken, and its contents escaped. After a repair of the leak, the erysipelas disappeared, but attacked the occupants of those same beds ten years afterwards. The same defect was proven to have again occurred, with the same results as before.

A similar instance occurred in the Charite Hospital in Berlin.

Cerebro-Spinal Meningitis has been observed to be favored by overcrowded sleeping-rooms, and the consequent loading of the air with animal emanations, and also "by the saturation of the soil with garbage and the products of decomposition as principal agents."

Malarial Fevers.—Dr. McLean, of England, says that these fevers are caused by decomposition in the soil in the presence of water, and that it disappears before cultivation and subsoil drainage.

Batavia, in New York, was at one time so malarious that it was almost depopulated. "Certain saturated lands," says Mr. Waring, "were drained, and for the last twenty years the town has been particularly free from these disorders."

In all malarial climates, there seem to be associated with this condition more or less neuralgia and muscular rheumatism, disordered livers and impaired digestion, which certainly seem to be improved just as soon as, with sanitary works, malaria disappears. That these malarious disorders do exist to a slight degree in this city no one can doubt, although, under an improved system of drainage, they have greatly decreased.

Consumption, though often hereditary, is, more frequently than is imagined, caused by improper hygiene. Whether a depraved state of the system, caused by a neglect of sanitary laws, paves an easy way for its inception, or it directly arises from a damp soil, the fact remains the same, that the construction of sanitary works certainly lowers the rate of mortality from this common disease.

The following table copied from Baldwin Latham's Work upon Sanitary Engineering, shows the decrease in the death rate, from consumption, which has been caused in England by sanitary works:

	Population in 1861.	Average mortality per 1000 before construction of works.	Average mortality per 1000 since completion of works.	Saving of life per cent.	Reduction of Typhoid Fever. Rate per cent.	Reduction in rate of Phthisis per cent.
Banbury	10,238	23.4	20.5	12½	48	41
Cardiff	32,954	33.2	22.6	32	40	17
Croydon	30,229	23.7	18.6	22	63	17
Dover	23,108	22.6	20.9	7	36	20
Ely	7,847	23.9	20.5	14	56	47
Leicester	68,056	26.4	25.2	4½	48	32
Macclesfield	27,475	29.8	23.7	20	48	31
Merthyr	52,778	33.2	26.2	18	60	11
Newport	24,756	31.8	21.6	32	36	32
Rugby	7,818	19.1	18.6	2½	10	43
Salisbury	9,030	27.5	21.9	20	75	49
Warwick	10,570	22.7	21.0	7½	52	19

In 1862, Dr. H. I. Bowditch, of Boston, addressed letters of inquiry to prominent physicians throughout the United States, asking their opinion of the relationship between pulmonary consumption and soil dampness. Out of the one hundred and ninety-one who answered, one hundred and sixty-eight gave it as their firm conviction, based upon many years of experience, that this relationship was very close and beyond dispute. About this same time, Dr. Buchanan, under the special directions of the Medical Officer to the Privy Council, carried on in England a similar investigation, which led him, independently of Dr. Bowditch, to affirm, as his unalterable opinion, that the great cause of pulmonary consumption was soil-dampness.

Scarlet Fever.—This disease, which is justly so much dreaded, is by many observers classed among the filth diseases. Although there are many who deny this, yet it certainly seems strange that this disease so often co-exists with unsanitary surroundings, and the mortality from it is diminished by sanitary works.

In all cities and towns scarlet fever prevails most extensively, and in its most fatal form, in the unsewered and filthy portions. In Cleveland, during the year 1876, out of the eighty-six cases of scarlet fever which occurred, nearly eighty per cent. occurred upon streets which were not sewered.

The diseases which have just been mentioned are not the only results of filth. Instead of being attacked with a well-marked disorder, it has often been noticed, that persons living in disobedience of hygienic laws, with filth about them, are liable to suffer from languor, loss of appetite, colic, diarrhœa and prostration—the penalties which they pay for their disregard of sanitary works. Dr. Parke says: "When sewer-gas penetrates into houses, and particularly into bed-rooms, it certainly causes a greatly impaired state of health, especially in children. They lose their appetite, become pale and languid, and suffer from diarrhœa; older persons suffer from headache, malaise and feverishness; there is often some degree of anaemia, and it is clear that the process of aeration of the blood is not perfectly carried on."

It may be very properly asked, as it very often is, why, if filth produces disease, it does not in every instance; for filth certainly exists much more frequently than does its offspring, disease. This is all very true; but it might be asked with just as much propriety, why, because a regiment loses one-half its men in battle, it does not lose the other half also.

It is a fact, well known to physicians, that of two persons, exposed to a disease under similar circumstances, one will be attacked with it, while the other will escape. Constitution, peculiarities of temperament, state of the system at the time, exert a powerful influence in determining any disease. Squire says that the constitution of an individual has a great influence in increasing the liability of families and individuals to recent disease. "Of two families, residing in the same house, several members of the one have suffered from diphtheria while all the others have escaped. A difference of susceptibility is observed even in members of the same family." "Allowing," says Dr.

McLean, "for the effects of similar diet, occupation, hygiene and chiefly for the degree of exposure to the same source of infection, it is yet impossible to contest the effects of family constitution, both in favoring the occurrence of the disease, and in disposing to a fatal termination."

The same person even, owing to a different state of health at different times, may contract a disease, from which at another time he might escape. It is well established that in our waking moments, when the system is active and vigorous, we may be exposed with impunity to baneful influences, which in sleep may make an impression upon us. "Individuals may walk or ride without fear through malarious districts, which it would be impossible to sleep in without danger."*

In the case of the epidemic of typhoid fever, which has been mentioned as breaking out in Clapham—the boys only were attacked, while the workmen escaped. Long exposure to unsanitary conditions may beget a tolerance of them, or what is more likely, as Dr. Folsom remarks, "the influence of these conditions is so gradual, that the transition from health to sickness is not noticed."

Whether these explanations are true or not, the stubborn fact remains that the zymotic diseases find their firmest foothold in the filthy portions of communities, and that an improvement in sanitary works is followed by a decrease in the death rate, and an improvement in the condition of health. If this were not true, if filth exerted no dangerous influence upon individuals and communities, Boards of Health and sanitary ordinances would be useless, and countries might be allowed to reek with filth, without fear of evil consequences.

CONTAGION OF DISEASES.

In asserting that a definite relation exists between filth and the zymotic diseases, I do not mean to affirm that in *every individual case* we must look to unsanitary conditions, as the only cause which exists for their production. Many of these diseases are contagious, some remarkably so, and once they have broken out, they may, by their contagious nature, be indefinitely spread.

There can be, I believe, no doubt of the contagiousness of diphtheria, of which, as has already been quoted, Dr. J. L. Smith says: "It is highly contagious through the breath or by personal contact, and therefore those children

* Dr. C. F. Folsom

of the poor, who are mildly affected by it, but who go about the streets or to the schools, often communicate it to children of the better class, who live in apartments that are clean and free from noxious gases, and who live, or endeavor to live in strict accordance with the laws of health."

A physician in this city contracted diphtheria from getting a piece of diphtheritic membrane in his throat, and upon going to his home in the country, the disease broke out in the family, which he was visiting. There had been no case in the town before his arrival. Oertel mentions several similar cases.

Reynolds mentions the case of a man, who was under his charge at the University College Hospital, for paralysis, subsequent to an attack of diphtheria, which he had contracted from holding his child in his arms,— the child at the time being so slightly ill, apparently, with diphtheria, that the sickness was not recognized until after its death from suffocation.

Sometimes the vitality of the contagium seems to last for a long time. In the British Medical Journal, published 1859, the following case is related: "A servant was taken ill twenty-two days after the occurrence of diphtheria in a house, in which she resided, and which was in a good sanitary condition. In this same county, another servant was attacked with this disease, and remained one month in the house, until she was convalescent enough to be removed. Ten days were allowed for cleansing and purifying the house, when the family, consisting of the mother and three children returned, having left on the first appearance of the disease. *Three weeks* after their return they were all attacked with diphtheria.

Another important fact to remember is, that the infection *may* be disseminated for an uncertain time, by those convalescent from the disease. A girl ten years of age was removed from home upon the outbreak of diphtheria, from which three children had died. Two other sisters, convalescent from the disease, went to the sea shore; one, five weeks from the commencement of her illness, and the other only three weeks, but from whom all traces of deposit had disappeared. They left together, and seemed equally well. They were joined by other members of the family, and in a week, by the child of ten mentioned above. Early in the following week symptoms of the disease showed itself in her and proved fatal.

A very short time also sometimes suffices for the development of the disease after exposure. Jenner mentions a case, where advanced symptoms

showed themselves thirty hours only after exposure. This case shows the insidious nature of the disease, and the necessity for carefully watching those who have been exposed.

Although the contagious nature of diphtheria has been almost universally acknowledged, yet its poison does not seem to have the power of very wide diffusion in the air, clinging more particularly to rooms and sometimes to houses. For this reason immediate isolation of the patient will often be sufficient for the protection of the well.

The knowledge of these facts led me to the publication of the following suggestions in November last:

"1. Since diphtheria, in a great degree, seems to be caused by filth, especially that arising from stagnant water, defective drainage, etc, it is incumbent upon the citizens, particularly those who inhabit houses not possessing the proper sewer connections, to keep their premises in all respects as clean as possible. Rigid sanitary inspection is now proceeding, and for your own good lend your assistance in this direction to the Health Department.

"2. Keep your children away from the houses, and from intercourse with the inmates of houses where the disease prevails.

"3. When you suspect that the disease has attacked any member of your family, isolate that member as completely as possible, without even waiting to be advised upon this point by your physician.

"4. Although it has not been definitely settled that diphtheria is contagious after death, yet as long as there is a reasonable doubt that such may be the case, do not allow your children to attend the funerals of those who have died from it, particularly where such funerals take place from the house.

"5. At the outset the disease is very often insidious, no local symptoms being complained of, nor recognized by the parents, until too late for successful treatment. Examine your children's throat from time to time; and if any undue redness or swelling is discovered, or if you are in doubt in regard to the appearances, send immediately for your physician, in order that treatment, if it is necessary, should be commenced early. This is particularly important, since the disease is much more successfully treated in its early stages than later, when it may terminate fatally in spite of all treatment. These precautions

should be taken without fail, and daily inspection of the throat made, where the disease has already attacked one member of the family.

"6. Suspicion should always be excited when a child complains of a sore throat, or when, without any complaint, it is languid, feverish, and has a discharge from its nostrils. In either event your physician should be immediately summoned.

"7. As there is every reason to believe that in every city many contagious diseases are widely spread by means of the schools, either from the attendance of children who come from infected houses, or who may be actually suffering themselves from unrecognized sickness, or who may have resumed their studies when convalescent from these diseases, before recovery is complete, therefore no child should be allowed to attend school when diphtheria exists in its family, nor when it has itself any symptons, no matter how slight, which should arouse suspicion; nor when it is convalescent from the disease, until the attending physician deems it perfectly safe for it so to do. It is far better that a child should be absent from school for a few days than that any risk should be incurred of transmitting the disease to others."

In regard to the contagiousness of scarlet fever, no doubt can be expressed, since many facts go to prove that this is the sole means by which it is spread. Medical literature is full of facts in support of this theory of contagion.

Sir Thomas Watson speaks of a piece of flannel, retaining its contagion for a year. Hildebrand was affected by a cloak, which after exposure to the disease, had been put away for eighteen months. Palente mentions the case of a mother, who had been exposed but a moment to the disease, communicating it to her children, after a walk of six miles.

Moore was confident that a piano, which stood in the sick room, communicated the disease. Murchison mentions the same thing of a lock of hair and a letter, which had come from the distance of one hundred miles. It has also been supposed to have been communicated by milk, which had stood in scarlet fever infected houses.

The contagion also seems to retain its vitality for some time. Murchison found that families had been attacked by the disease, after returning to a house, in which scarlet fever had existed several months before. Thomas relates

cases, where the disease was communicated *ten weeks* after the fever had subsided in the first child.

It may also be transmitted to another in a very short time after its commencement.

Thomas says that it is contagious from its commencement.

Trousseau mentions the case of a young lady meeting, in Paris, her sister who had contracted scarlet fever in travelling from London to Paris. The first sister was attacked with it within twenty-four hours afterwards.

On the other hand, it may be communicated weeks after the actual disease has disappeared.

Dr. Gee says that the scales, which come off in the disease, are all but permanently contagious.

In the Berlin Infirmary, no scarlet fever patient is admitted; but a child, dropsical from the disease, in whom all desquamation had ceased was admitted without question. Scarlet fever soon broke out in the institution.

Notwithstanding the great contagiousness of the disease, it is probable that the poison is inoperative two or three feet from the patient, but as it is supposed to be very volatile it can be easily wafted through the house. Immediate isolation is therefore necessary.

Through the medium of the schools both scarlet fever and diphtheria are capable of a wide dissemination, a fact which is now claiming the serious attention of physicians, and Boards of Health. Within the last twenty-five years, it is estimated that five thousand children have died in Boston from scarlet fever, contracted in the public schools. There is no good reason why these diseases should not be spread by this agency; on the contrary, there is every opportunity for this accident to occur, with children crowded together in, as it too often occurs, a badly ventilated room, and coming into actual contact with each other. Sometimes these affections come on insidiously, and in consequence children are allowed to go to school to communicate the disease, which in them may be mild, to others, who may be thus attacked with the severer forms. I am very confident that many cases of obscure origin are to be explained in this way.

That these contagious diseases are also spread by funerals, is now thought to be very probable, particularly where they are attended by a number of children. A short time since, a commission was appointed in Boston to investigate this subject, and after a careful and extensive correspondence with many physicians, it reported that, although it had not been definitely proven, yet many facts and cases led to the belief that public funerals did contribute to the dissemination of these diseases, and therefore advised against them.

Following out these investigations, the Board of Health of New York has recently issued a circular, cautioning the community against public or church funerals of those who have died, not only of diphtheria, but also of scarlet fever, measles and whooping cough.

In view of these facts, considering the contagious nature of these diseases, I would strongly urge upon your Honorable Body the necessity for passing ordinances, which would in every way protect the community against their spread, and would respectfully recommend that wherever, in our sanitary ordinances, (except in Section 37) the words "dangerous contagious diseases" occur, before them the words "scarlet fever and diphtheria" shall be inserted.

I would still further suggest, that a rule be adopted by the Board of Health, prohibiting any child from any family, where scarlet fever has occurred, from attending school until four weeks have elapsed since the commencement of the last case of such sickness, and furthermore that no child should be allowed to attend school from a family in which there has been a recent case of small pox, scarlet fever or diphtheria, without a certificate from the attending physician, endorsed by the Health Officer, that all danger from communicating these diseases, has entirely passed.

I am well aware that it is very important, that a course of study should not be broken up by an absence from school, but I deem it of far more importance, that a child should not pay the penalty of, it may be, a loss of health or life, from the carelessness of others.

In consideration of the fact that diphtheria and scarlet fever may be spread by funerals, I would respectfully ask you to consider the advisability of restricting the numbers of those who may attend such, and of compelling the bodies of those, who may have died of these diseases, to be carried in a hearse instead of a carriage.

These regulations are simply applying the same rule to these dangerous contagious diseases, as has hitherto been applied to small-pox. From the ravages of this latter disease the community can be protected by vaccination, but no such protection can be afforded to it against the spread of these other dangerous diseases, which annually carry off in all cities so many children, and, in case of scarlet fever at least, so often produces a serious and lasting impairment of health.

The wisdom of controlling the dissemination of scarlet fever and diphtheria, as well as small-pox, by ordinance, can no longer be a matter of doubt, when the relative frequency of their occurrence is considered. In 1875 there were 83 deaths from scarlet fever in Cleveland, and 243 from diphtheria; while there were only 3 deaths from small-pox.

In 1876, there were 45 deaths from scarlet fever, 395 from diphtheria, and only 4 from small-pox.

In Boston during the years 1874, 1875, and 1876, there were 1,282 deaths from scarlet fever, (in the year 1875, 418 from diphtheria,) while there were only 6 from small-pox.

The mortality from scarlet fever in England and Wales from 1848 to 1855, was 1-25, and in some years 1-20 of the whole number of deaths.

Out of a series of 148,827 deaths from scarlet fever, collected by Murchison, 142,337 were of children under fifteen years of age, showing that the predisposition lessens with advancing years, which is not the case with small-pox. It is therefore incumbent upon us, in every possible way, to protect children from the ravages of these diseases.

The propriety of accomplishing this object by rules adopted by the Boards of Health, has lately been discussed in several cities. Boston and several other cities and towns have already passed the necessary ordinances, and New York is seriously contemplating the same proceeding. In Chicago, the presence of scarlet fever in a house is indicated by a card, with the words "Scarlet Fever Within" printed upon it. In the light of our vital statistics for the past two years, Cleveland ought not to be behindhand in these precautionary measures, but should immediately adopt some such provisions, as have already been mentioned.

In this connection, I desire to call your attention to Sections 29 and 30 of the old ordinances, which make an exception, in regard to vaccination, of those children, who have had small-pox or varioloid. As it is well known that vaccination protects better than even small-pox or varioloid, and that of two persons, the one, who has had an attack of either of these diseases, but who has not been vaccinated, may succumb to a second attack, while the other, who has been vaccinated, may escape altogether, I would recommend that the words, "or not having had the small-pox or varioloid," in the 29th Section, and the words, "or has had the small-pox or varioloid," in the 30th Section, be stricken out. This would compel *every* child to be vaccinated before entering a school.

CHAPTER II.

HOW FILTH IS INTRODUCED INTO THE SYSTEM.

Recognizing the intimate relation which is now supposed to exist between certain diseases and filth, the next practical enquiry, having for its object the extermination of preventable diseases, which arises, is how filth, or the germs of disease are carried into the system; that is, into the blood or bowels, to produce a morbid condition. This may be accomplished, as may be inferred, from what has preceded, through two channels, viz: through the stomach or lungs; that is, we may either drink or eat it, or we may inhale it with the air we breathe. In the former case it is a liquid or solid filth, and in the latter a gaseous one.

Upon these points scientific men are agreed. Dr. Simon says: "Two chief sorts of danger arise; one, that volatile effluvia from the refuse, polluting the surrounding air, and everything which it contains; the other, that the liquid parts of the refuse pass by leakage or soakage into the surrounding soil, to mingle there of course in whatever water the soil yields, and in certain cases, thus to occasion the deadliest pollution of wells and springs."

DRINKING WATER.

As in this city the drinking water is derived either from Lake Erie, or from wells, it is not necessary to refer to the supply from streams, from which many smaller communities derive their drinking water. Of our lake water, which, unless contaminated by accidental causes or by defective plumbing inside of houses, is usually pure, nothing need be said: but we are chiefly interested in the remaining source of supply from wells, which unfortunately for health, are so largely used in certain districts of this city. I say unfortunately for health,—because of all sources of water supply, wells are the most dangerous, particularly in towns and cities, on account of the ease with which their waters become polluted, and thus cause disease.

The Medical Officer to the British Privy Council, says: "There cannot be the slightest doubt, that in densely inhabited areas, however rightly refuse may be disposed of, surface wells can never be other than a dangerous source of supply. Even deep wells are only possible under certain geological conditions, and then only, where it has been clearly demonstrated that they are safe from downward pollution.

"Impure water is the chief way of filth infections finding their way into the human body, so that for the prevention of filth diseases a very strict insistance on purity of water supply is essential. It is a matter, in regard to which, no sort of compromise should be considered safe."

Hart, in his "Manual of Public Hygiene," says that sub-soil wells in large towns *cannot* be sufficiently pure to be safely used for drinking purposes.

The extent to which wells may become contaminated even in small towns is sometimes alarming. In 90 out of 188 towns in Massachusetts, the wells were exposed to pollution from defective sewerage, and from these 90, sixty-three towns reported to the State Board of Health, distinct resulting disease; almost all of these 63 instances represented several cases of disease, "many tens and some even scores."

The reason why well-water is so frequently bad and unwholesome, is because sink drains, badly made house drains, privies, cesspools, etc., empty their foul contents into them by percolation through the soil, particularly if it is a porous one, and has an underlying stratum of clay or rock, which furnish an excellent bed, upon which liquids can flow.

"A well may be good for some time," says Col. Waring, "and subsequently become poisoned, because the soil, lying between the source of the impurity and the well has a certain amount of cleansing power. While this is *effectual* every impurity is withheld, but by degrees the soil becomes foul further and and further on, until at last there is no grain of uncorrupted earth between the source of pollution and our only source of the pure water, without which we cannot live in health, no matter whether this water is *stream, well or spring.*"

"The well," he says, "is in effect a deeper drain, toward which the water from the surrounding earth finds its way: and in time as impurities will follow water to any outlet, unless the filter, which holds them back remains

always active, the foulness of the earth within the draining range of the well is carried into the water, which it renders unfit for human use."

If the filth supply is constantly kept up, if the earth in consequence continues to be soaked with it, no opportunity is given for the purification of the soil by oxidation, and it becomes saturated by degrees until the saturation reaches the well.

Even if there are copious rains, which soak into the ground and dilute the filth, it does not follow that the danger has been obviated, since this dilution only renders the liability to disease less in each particular mouthful of water. In the aggregate, there is just as much filth, just as much pollution in the water. In seasons of drought the well draws up its supply from a larger area, its range of drainage being extended, and consequently the danger from this source is increased. This will explain the increase of typhoid fever, which is often noticed in dry weather, the typhoid poison being drawn from a greater distance. If the drought is followed by copious rains, the danger of the water becoming polluted is very much weakened.

In Terling, Essex, out of the entire population of 600, three hundred were attacked with typhoid fever. It was discovered by the commission, appointed to enquire into the cause, that the wells were situated in a porous soil, and that ten days before the outbreak of the fever, after an extraordinary drought, a sudden great rise in the water level of the wells was observed. "This of course denoted a long delayed scouring of the foulest soil into the water supply of the now poisoned population. We have had no outbreak of diphtheria, but it is present more or less constantly."

One great cause of the pollution of wells, is the cesspool, which exists more or less extensively in this city, not only in the poorer portions, but in some of the very best localities, and which according to the highest authorities should never be used even in a village, so great is the danger arising from them. These cesspools are seldom if ever made tight. Lindley, the distinguished English Engineer of the Hamburg and Frankfort Sewerage Works, says that they *never* can be made tight. Some few are made of brick or cement, the greater majority of them of wood, or are simply excavations in the ground, designedly leaky in many cases, to avoid expense in building, and in cleaning.

In consequence of ther faulty construction, their contents, no matter whether they are simply kitchen slops, or privy matters (and the danger is equally great

in either case) will escape and leak through the soil, if porous,—a process which is still further favored by every rain which falls, and usually into the nearest well. "For every well," says Dr. Winsor, "is the drain for the moisture of a circumjacent region, which, at its minimum, corresponds to an inverted cone, with its apex at the bottom of the well, and with its base on the surface of the ground, at least as broad as the well is deep."

In the latter part of 1859, Bedford, England, was the seat of a severe outbreak of typhoid fever. Upon investigation it was found, that the epidemic did not follow the course of the sewers, but there was every reason to believe that it was due to fœcal matter, soaking into the wells, from the cesspools of the town. "The water from these wells was found to contain a large quality of organic matter, evidently derived from the sources alluded to."

The most fruitful cause however of water pollution is the privy vault, which in a similar manner to the cesspool (which is nothing but a privy) affects the health of communities, which depend upon well water for drinking purposes. This is a serious evil, on account of its extensive prevalence, and one which is considered of all filth influences, which prevail against human life, to operate undoubtedly to far the largest extent.

Col. Waring says of them: "So too if they be used only for their legitimate purpose, *if no liquid matter be poured* into them, and they have copious *daily* sprinkling with dry earth or ashes, they will be free from sanitary objection; or if they be cemented perfectly tight, and if the contents be disinfected daily with carbolic acid, sulphate of iron or other suitable disinfectant. But if these precautions are not adopted, and carried into effect under a rigid supervision, there is no single appurtenance of the life of an ordinary household so fraught with danger and annoyance to all who live within reach of its influence."

Prof. S. W. Johnson, of the Yale Scientific School, says: "The use of open vaults or water closets, emptying in cesspools, tends to fill up the soil with fœcal matter. A single vault poisons a circumscribed space around it. External to this limit, the filth is destroyed by the action of the oxygen of the air, which is the great purifier. Within the limit named, the animal matters preponderate, either constantly, or at some period of the year. They may long remain simply disagreeable, without being dangerous, and may again of a sudden, in a way whose details have as yet escaped investigation, become the

seed-bed or the nursery of the infection, which breaks out into fevers and dysentery. The danger increases, as the quality of filth and the number of its receptacles increase. To cover them up does not necessarily remove the evil. The putrid matters soak into the soil, and move upwards and downwards in it with the motion of the soil water. When we have copious rains, they are carried down perhaps to nearly the level of the water in our wells. In the heat and drought of August, these matters rise again. In the absence of rain, the rapid drying of the surface creates an upward capillary flow of the ground water. The matters, which, in rainy times, follow the surface waters to the depths, in drought, follows the ground water to the surface."

Eassie, Hart, Parkes, and other sanitarians have expressed similar views.

We have only to reflect upon the usual method, in which these vaults are constructed, to recognize the truth of these assertions. They are ordinarily nothing but a receptacle, dug to a greater or lesser depth into the ground, with no other walls but those which the earth furnishes. Even if they are walled in with wood or brick, which is not common, it makes but little difference; for their liquid contents will, in either case, escape through the soil, to poison both the neighboring wells, and the air by their gaseous emanations. All this, with the open clearing out, (an evil, which in this city is about to be discontinued), creates a nuisance, which persons, unacquainted with its operation, can scarcely realize, since "the infectious pollution of the water and air, which it occasions throughout all countries, are efficient means in spreading many fatal filth diseases."

Another source of danger arises from the common practice, in imperfectly drained districts, of throwing the liquid refuse, house and kitchen slops, etc., directly upon the ground, which in course of time, as the custom is kept up, must pollute the atmosphere, and, by soaking into the ground, the wells within this drainage area.

Of the pollution of wells by the same process of filth, leaching from stables, manure piles, etc., there is no necessity to speak, since evils arising from this source are seldom found in this city.

During the cholera epidemic in London, in 1866, posters were placed upon the city pumps, stating that the water was not fit for drinking purposes.

So easy is this pollution of water, even upon level ground, that it is estimated that, whenever dwellings are situated within one hundred feet of each

other, there is danger that the wells may become contaminated through some of the agencies mentioned above. Bnt if these houses are situated more closely together, if, as it sometimes happens in this city, the wells and privies are placed within a few feet of each other, the chances of this pollution become infinitely increased.

Filth, however, has been known to leach through the soil to a greater distance than one hundred feet. Eassie mentions a case of the contents of a cesspool poisoning a well *two hundred yards* distant.

In France, wells have been rendered unfit for use by pollution from a distance of *six hundred and fifty feet.*

If this will occur when the source of filth and the well are upon the same level, how much more readily will contamination take place if the well is upon a lower plane, as so often occurs.

The following case, reported by Mr. Child, Health Officer for a portion of Oxfordshire, England, forcibly illustrates the distance from which wells may be contaminated :—

" In consequence of the escape of the contents of a barrel of petroleum or benzoline, which had been buried in an orchard, a circnit of wells sixty feet below and 250 or 300 yards distant became so affected that the occupiers of fifteen houses, containing eighty-two inhabitants, were for ten days unable to use the water for drinking or cooking. The cattle of one of the proprietors. moreover, refused to drink at the spring where they were accustomed to drink. Had this soakage been sewage instead of petroleum, who can doubt that the result might have been wholesale water-poisoning and an outbreak of typhoid fever ? "

If, therefore, a number of houses, using wells, privy vaults or cesspools, are situated upon a hill-side, unless this locality is thoroughly and perfectly drained, the *inevitable* result will be a pollution of the drinking water from higher up the slope, either from a person's own privy, which is generally situated on a higher level than the well, or from those which are located on a still higher plane. This is a fact, which many people ignore, and consequently persist in using water, which from the conformity of the grounnd must be unfit to drink, or will perpetuate the nuisance of a privy or a cesspool, regardless of the consequences to their neighbors.

Another mistake, which is so often committed, is to suppose that, because the source of pollution is on a lower level than the well, the latter is necessarily protected, since fluids cannot run up hill. This is very true; but the contents of the cesspool or vault, for instance, may be several feet higher than the bottom of the well, and although the underground drainage, which supplies the well, runs in a direction, indicated by the slope, there is no certainty that in particular formations this is always so. There are many seasons when the well is low; and, at such times, there is a possibility that the liquid filth may leach from the cesspool or vault, although on a lower plane than the top of the well, downwards in the direction of the nearly empty well, whose bottom is many feet below.

If the pollution of our drinking water could always be made manifest by a disagreeable odor or unpleasant taste, the danger to health would be infinitely less, for under these circumstances most persons would discontinue their contaminated supply. But unfortunately, the dangerous character of these waters is often indicated neither by the odor nor taste of impurities. The fact that a water is clear and palatable, is no proof whatsoever of its purity, since these conditions have been markedly present in some waters most shockingly polluted with sewage, as indicated by microscopical and chemical examinations. Some of the most dangerous waters are especially bright, sparkling and refreshing, but "the chemical process, which may have made them so, may have had no effect upon the 'germs' of disease which they contain," and which have been known to produce the most dangerous results.

In only one out of the large number of well waters, which I have caused to be examined this Fall and Winter, was there anything, which would have possibly indicated, either to the sense of smell or taste, their dangerous character, and yet they were all so polluted with privy filth, as to be totally unfit for use.

Of four wells, examined in North Hadley, a country town in Massachusetts, and found so contaminated that they had to be discontinued, every one furnished a supply of water, which was very pleasant to the taste.

The water of the Aldgate Pump in London, has always been noted for its purity and its very pleasant, cool and sparkling taste; so much so, that persons have resorted to it from far and near, on account of its supposed medicinal properties. Lately however it has been analyzed by Prof. Wanklyn,

who found, that "its refreshing, sparkling character was due to its impregnation by the salts of decomposing sewage, which had found their way into the well."

Lassie had some water, taken from a well in a healthy locality, analyzed, and it was found to be absolutely poisonous, though very pleasant to the taste. Its contamination was supposed to have been due to the filth of an old farm yard, which had formerly stood on the premises. The families, which had used this water, had long been suffering from a skin disease.

Dr. Letheby says that very many of the polluted wells in London yielded cool, bright and sparkling water, and yet in the Sixth Report of the Rivers Pollution Commission of England it is stated, that the waters of these wells consisted chiefly or entirely of the leakage of sewers and cesspools, and some of them had actually a manure value, 150 per cent. greater than the average London sewage.

In one epidemic of cholera, which occurred in London in 1848-9, the Broad Street Pump, which, on account of its supposed purity, was extensively used by all classes, was estimated to have caused the deaths of six hundred and nine persons at least, so shockingly was it polluted by cesspool filth.

From these examples, chosen out of the large number, which the literature of the subject furnishes, it can be readily understood, how dangerous is the use of well-water, particularly in crowded localities; since oftentimes its poisonous character can only be detected by a chemical analysis. Even then its impurities will sometimes escape detection, for until chemistry shall have learned to indentify the *materies morbi* themselves, (which are sometimes so small that no microscope can discover them), its competence to declare them absent in any given case must evidently be judged impossible, and waters, which chemical analyses have pronounced pure, may be carrying in them the very elements of fatal disease.

"Chemical analysis," says Dr. Winsor, "though a very valuable means of ascertaining the quality of water, is not alone sufficient. Especially it may fail to detect organic impurities in a water which is carrying the poison of typhoid fever or of cholera, an incredibly small amount of which is sometimes sufficient to set up the specific morbid action of those diseases in persons, receiving said poison in their drinking-water."

"A water-supply whose quality is *somewhat* deteriorated by the constant admixture of sewage, but not to such a degree as to lead the chemist to *condemn*

it, or to cause distinct diseases or increased death-rate among its consumers, *may yet gradually and insidiously lower their vigor,* so that when the time comes—as come it must in the case of streams which receive sewage from privies and water-closets—that some of the above-mentioned evacuations enter a water-supply, the zymotic poison, then conveyed to the damaged constitutions of those using it, will find them prepared to yield to the morbific influence, as the feeble and sickly everywhere succumb to disease which stronger and healthier constitutions resist successfully."

The direct relations, which exist between many diseases and well-water, have been abundantly proven by experience.

In 1847, the inmates of thirteen out of thirty-four houses, situated in Richmond Terrace, Clifton, England, who procured their drinking-water from a certain well, which was discovered upon analysis to be contaminated with sewage, were attacked with typhoid fever. Those, residing in the remaining twenty-one houses, who were dependent for their drinking-water upon another source, escaped entirely.

Dr. Stephen Smith relates a case of six members of one family, who died from typhoid fever, which was caused by the use of water from a brook, contaminated by the surface drainage from a barn-yard higher up.

An epidemic of typhoid fever, mentioned by Liebermeister, occurred in Basle in 1867, in which thirty-six persons were attacked within twenty-two days. The well, from which these persons derived their drinking-water, was fed from a canal, into which a privy emptied. After the well had been abandoned, there was no new case of the disease. A little later three more cases occurred in persons, who had disobeyed the municipal orders, and used the well. After the well had been completely closed up, no more cases occurred.

The connection between fouled drinking-water and diphtheria cannot so readily be made out, since in many of our large cities the use of wells has been discontinued. But that this relation does exist; that is, that filth introduced into the system through the water may cause this disease, seems to be very probable.

In the last Report of the State Board of Health of Massachusetts, it was stated "that in some of the towns, reporting on diphtheria, the contamination of the drinking-water appeared at least to be partially at fault;" in a few

instances the Report states " the evidence is quite strong as to its being, if no more, a cause of unusual severity in the symptoms, and of its more extensive prevalence."

Every one of the specimens of well-water, which I have had examined this winter, on account of the fatal prevalence of diphtheria in the families using this water, was contaminated, and some of them to a very great degree.

Several epidemics of diphtheria have occurred in Medway, Mass., which have been directly attributed by the physicians of the place to polluted drinking-water.

In 1874 an epidemic of this disease visited West Springfield, Mass., which the sanitary reporter attributed to the close proximity of the wells and privies.

In the " Ediburgh Medical and Surgical Journal," for September, 1872, Dr. Menzies reports several cases of diphtheria, which occurred in Naples, and which in his estimation were undoubtedly caused by polluted water.

In Terling, Essex, sanitary inspection revealed the fact, that the wells were badly contaminated by privy filth, and though there had been no epidemic of diphtheria, yet, according to the report, it was present more or less constantly.

MILK.

As detrimental to health as polluted water is, its dangers are still further increased by its ability to affect other fluids, with which it is brought into contact. Evidence is steadily increasing that milk, an article of every-day use, may be so contaminated by it as to be unfit for use.

In 1876 a serious epidemic of typhoid fever, in which two hundred persons were attacked and from which fifteen died, broke out in Eagley, a village of Lancashire, England. Upon investigation, it was discovered that all those attacked obtained their milk from a single dairy, and in those families, the members, who were particularly milk drinkers, were especially affected, while in the adjoining houses, where the milk was not used, no cases had occurred. The resident medical officer after a careful examination made the following report :—

" First, that the milk from the suspected farm was the vehicle in which the fever poison was conveyed to all the individuals attacked ; and secondly, that

the poison was introduced into the milk, either by the adulteration of it by water, containing fœcal matter or the germs of typhoid fever, or by washing the dairy utensils and milk cans in water contaminated in like manner."

There was no evidence that the milk had been purposely adulterated with water, but it was found that the dairy utensils had been washed in water, taken from a stream which was shockingly polluted by filth. The water supply of the village was found pure and wholesome.

In 1873 a serious and wide-spread epidemic of this same disease occurred in London, chiefly in and about Marylebone. This case was of peculiar interest from the fact that the milk was brought from a filthy locality forty or fifty miles distant, to exert its deleterious influence in a healthy portion of the city, and also, as the disease happened to break out in the families of more than a dozen physicians, the matter received the closest attention, in order that the cause might be discovered. It was proven beyond doubt that the dangerous milk had been contaminated by water, drawn from a well polluted by excremental filth.

The report of Mr. Radcliffe, as given in the Report of the Medical Officer to the Privy Council, upon the subject, concludes as follows:—"How the dairyman's water was enabled to spread its influence to his milk, and by what proportionate admixture it did so, are questions of little importance to my present subject matter. The essential point is, that the water with which a dairyman washes his pails, and of which a very variable quantity may, under varying circumstances, remain in them, as an addition to his milk, is not likely to be of better quality than that which he and his local sanitary authority consider good enough for his own drinking; and that in regard to this and many like possibilities of casual filth infection, the general public are in intimate sanitary partnership with various of their purveyors of food."

Dr. H. I. Bowditch reports an instance of thirty-one cases of typhoid fever, occuring among the members of the same family, occupying different houses, which were undoubtedly caused by the contamination of the drinking water, and consequently that of the milk.

Similar cases have been noted in other sections of our country; in Islington, England, in 1872, in Armley in 1872, and in Mosely and Balsall Heath.

Although no cases of disease have occurred in this city, which could be directly traced to an impure milk supply, yet it is but right that the possibility

of such an occurrence should be understood, and means taken for its prevention.

In connection with this subject, I would respectfully suggest that a standard of pure milk (100°) should be adopted by your Honorable Board, and that it should be ordained, that all persons, selling milk below 90°, should be prosecuted. At the same time, I desire to call attention to the fact, which was lately brought out by Prof. Doremus, at a trial recently held in New York, that *cream* itself will lower the standard of pure milk as well as water.

Owing to the facts, which have been adduced in proof of the evil effects, much may arise from the use of polluted water, I would most firmly urge upon your Board the necessity of as rapidly as possible discontinuing the present large source of water supply from wells, which are so extensively used in this city, and the substitution for it of the pure water, which is obtained from Lake Erie. This seems to be so important, particularly since we have such an immense reservoir of pure water close at hand, that in my estimation it would be desirable, in certain districts, to reduce the present guarantee of 10 per cent. on the original cost, as an inducement to householders to supply themselves with Lake water.

Unless some provision of this kind is made, and a more extensive supply of pure water is furnished, the time will come, if it has not already, when the wells, now in use, will be made the vehicle for the spread of any zymotic disease, which may break out here in its epidemic form.

ICE.

In connection with this subject, a practical enquiry suggests itself, as to whether ice, formed from impure water may not be prejudicial to health, if used for drinking purposes.

It is a prevalent belief, that the vitality of organic impurities and disease germs may be destroyed by the action of cold, so as to become entirely inoperative. This may be true of some, but there are many others, which are active chiefly during cold weather, and others still, which seem to remain latent, only to be revived again under the influence of heat.

The following interesting case, which occurred during the summer of 1875,

at Rye Beach, N. H., has been published by Dr. A. H. Nichols, who investigated it :—

An extensive epidemic, characterized by symptoms of giddiness, nausea, vomiting, colic and diarrhœa, broke out in, and was confined to one of the leading hotels, containing three hundred guests. The drinking-water was found to be pure; the milk and provisions were examined, and proved to be excellent; the cooking utensils and everything connected with the kitchen were perfectly clean; and finally the whole system of drainage and sewerage had been pronounced perfect by eminent engineers. As furnishing some clue to the cause of this outbreak, it was noted that some of the persons in the hotel, apprehensive of trouble from the drinking-water, had used other beverages cooled by ice, but notwithstanding this precaution, they were affected in the same way as the others.

The ice was thereupon examined, and found to emit a disagreeble odor upon melting; the atmosphere of the ice-house was offensive, and when some of the melted ice was placed in a glass before a dark object, it was found to be discolored and charged with organic matters, suspended in it. The pond, from which the ice had been taken, was discovered upon inspection to be a shallow marshy body of water, into which saw-dust from some neighboring saw-mills had been carrid down by a small stream. The outlet to this pond had been blocked up, and was filled with marsh-mud and decomposing saw-dust. A chemical examination of the ice showed that it was richly impregnated by organic impurities, and totally unfit for domestic use.

In consideration of the inferences to be drawn from this and similar cases, which have been reported, viz :—that ice, cut from any body of water, which is itself unfit to drink, is likewise prejudicial to health and should therefore not be used for consumption, I would respectfully recommend that an ordinance be passed, prohibiting the sale of ice for domestic purposes, which has been cut from any stagnant body of water, or water which is otherwise unfit for drinking purposes.

No *certain* evidence has as yet been found that impure ice is sold in this city for consumption, and yet with the possibility that such may be the case, this subject will be thoroughly investigated at the proper season.

LEAD PIPES.

In this connection I desire to call your attention to the fact that the use of drinking water conveyed through lead pipes, especially if it has remained standing in them for some time, or stored in leaden cisterns, is always attended with a certain amount of danger; since such water almost always contains lead in solution, the danger varying with the character of the water and the susceptibility of those who use it. All waters, whether hard or soft, pure or impure, with the exception perhaps of those which are perfectly pure, in the absence of air, will act upon lead in such a way as to corrode it, and form with it soluble salts of this metal, which taken into the stomach produce certain evil effects.

Of the various kinds of water, those which contain the sulphates, carbonates or phosphates, such as our Lake water, have a comparatively feeble action upon lead, and consequently to a very great extent innoxious. The most dangerous are the purest and most highly oxygenated, such as are found in many wells and springs.

Notwithstanding the comparative innocuousness of certain waters, it never can be *positively* asserted that they do not, under certain circumstances, take up and convey a certain proportion of lead, until it has been definitely proven *by long use* that they have not exerted a deleterious influence upon the health of those who drink them.

There are other circumstances which favor the corrosion of lead pipes by water passing through them. The injurious action is always noticed to have been greater at those points where the pipes have been sharply bent, or where the lead has been brought into contact with other metals, such as solder or stop-cocks of metal or alloy, or where the water is carried through them at an elevated temperature.*

The amount of lead, necessary to produce its injurious effects, varies with the susceptibility of individuals. Children as a rule are more easily affected than adults. Dr. Angus Smith refers to a case of lead paralysis, in which as little as one-hundredth of a grain per gallon was detected in the water.

* Professor Nichols, of the Boston Institute of Technology, found one-ninth of a grain of lead in an U. S. gallon of water in the *hot*-water pipes of a private residence. A case of lead poisoning occurred a few years since in New York, which was traced to the use of Croton water drawn from the hot-water pipes after standing in them all night. "In this water cracked wheat was soaked every morning before boiling."

Dr. Adams, of Massachusetts, speaks also of the same small amount causing paralysis. Dr. Parkes thinks that any quantity over one-twentieth of a grain per gallon should be considered dangerous. Calvert found that in Manchester, (England); one-tenth to three-tenths grains per gallon had been decidedly injurious. In the celebrated case of the poisoning of Louis Phillipe's family at Claremont, the amount of lead was seven-tenths of a grain per gallon. This quantity affected thirty-four per cent. of those who drank it.

A large number of cases of lead poisoning from the use of water conveyed through lead pipes have been reported. One instance is instructive, as showing that for a long time a family may use such water with impunity, and yet by an accident, (in this case the decaying of the wooden well-cover which, falling into the well, had supplied the excess of carbonic acid gas necessary to act upon the lead pipe), become suddenly affected. Not only will water, coming in contact with lead, corrode the pipes, but other fluids, such as cider, vinegar, ale beer, etc., will have the same action. Many cases have been mentioned, where individuals have been poisoned by these liquids passing through lead pipes or faucets. In France and Germany there is a government law, which compels the use of tin pipes, and nothing else, in the wine and beer establishments.*

Although lead, introduced into the system in larger amounts, may produce the characteristic symptoms of lead poisoning, viz:—colic, constipation, paralysis, wrist drop, etc., yet in smaller amounts it is very certain that, even if these symptoms are not produced, it will gradually undermine the health, causing or increasing various disorders, particularly of the nervous system; and the causes of these indefinite symptoms may not be suspected by the sufferer, nor even by the medical attendant, until some other member of the family or a neighbor, using the same water, who is more susceptible to morbid influences, exhibits the more marked symptoms of lead poisoning.

Dr. B. W. Richardson, a well known observer, says:—"Contamination of water, both hard and soft, impure and pure, by lead, is in all parts of the kingdom (England), and under every variety of circumstances, the cause or sources of various obscure diseases of man (and also doubtless of the lower animals) of the nature especially of dyspepsia and colic."

* The use of many cosmetics for the complexion containing, as they do, lead, should for this reason, if no other, be discountenanced. Several years ago Dr. Sayre of New York reported a case of lead poisoning, occurring from the use of a well-known cosmetic.

To remedy the evils arising from the use of lead, pipes made from other materials have been brought into use. The best of these is "galvanized" iron pipes, made by passing iron pipes, cleaned by dilute acid, through a bath of molten zinc. It has been objected to the use of galvanized iron for carrying potable water, that the zinc may impart a poisonous quality to the water. But, although oxide and carbonate of zinc may be found in the water thus conveyed, these salts are in such infinitesimal quantities, that, according to the authority of the most distinguished observers, they exert no deleterious action whatsoever upon the system.*

The only objection to the iron pipe is, that it is illy adapted to the many turns which house plumbing necessitates, and its liability to split under high pressure or in frosty weather. Wherever it can be used, however, it should be employed.

There is another pipe, which has proved eminently satisfactory in England, and in this country; that is, a *block tin* pipe, enclosed in one of lead. If the tin is good, it is but very little acted upon by the water passing through it, and the strength of the pipe is increased; while bends and junctions can be made without destroying the continuity of the tin.† The tin is not what is called tinned on the outer lead casing, by pouring melted tin through the pipe, or by electro-plating it inside; for pipe, thus treated, offers no efficient protection against the removal of the tin by the friction of the water.

Although the composition of our Lake water is such as to render it almost innocuous, even when conveyed by the ordinary lead pipes, as shown by the experiments conducted by Dr. J. L. Cassells in 1866,‡ yet, as it is never

* Carbonate of Zinc is administered very frequently as a medicine, but its effects are very slight.

† This pipe has been endorsed by such distinguished men as Drs. Lankester, Letheby and others.

‡ "The following examinations and experiments were made on the Lake Erie water distributed in our city, in reference to its action on lead. A gallon of the water taken from the Weddell House office, was evaporated at a temperature of 180° F. to four ounces, and tested for lead. Two ounces of this had a stream of sulphydric acid gas passed into it. The other two ounces were filtered, acidulated with nitric acid, and evaporated to dryness. After expelling the excess of nitric acid by heat, it was dissolved in distilled water, and divided into three equal parts; sulphydric acid gas was passed into one, solution of iodide of potassium into another, and the chromate of potash into the third. Neither of these tests gave indications of lead. A similar examination, with the same result, was made on water taken from the second story of my residence on Euclid Avenue. This was drawn in the morning, when the water had lain in the pipes ten or twelve hours. In other examinations, made at different times, and on water collected at different localities, in the city, I have in every instance failed to detect lead."

perfectly safe, under all circumstances, to make use of any water for drinking or culinary purposes, after coming into contact with the lead, pipes made from galvanized iron or block tin and lead are to be recommended. As it is always dangerous to take into the system any water, which has stood for a length of time in lead pipes, especially from the hot water faucet, it is very necessary that these pipes should be thoroughly emptied in the morning, before the water is used.

SEWER GAS.

As dangerous as polluted water is, when taken into the stomach, more injurious still is the inhalation of air, comtaminated by the products or gases of decomposition; since we drink but a few pints of water in twenty-four hours, while in the same period we inhale one or two thousand gallons of air, which, through the medium of the lungs, is taken directly into the blood. In fact this is the only channel, through which the germs of certain diseases are ever carried into the system.

When these gases which vitiate the air, are "the emanations from waste matters, undergoing decomposition in the absence of light and air, and in the presence of water, whether in a sewer, house-drain, cesspool, privy-vault, a compost heap, or in a wet unventilated cellar, they are known under the general name of sewer-gas." (*Waring.*)

These gases which are more or less found in the sewers of towns, are of two kinds, viz:—those composed of carbonic acid, nitrogen, carburetted hydrogen (due to leakage from gas pipes), sulphuretted hydrogen, ammoniacal compounds; and noxious organic vapours.

The former class are dangerous, only as they produce their chemical effects upon the system, causing, when diluted, headache and discomfort, and in those, habitually exposed to them, a vaguely depressed state of health; or, when sufficiently concentrated, instant death.

The most noxious of these gases are carbonic acid, or choke damp as it is called in mining districts, which is usually found in sewers and always in those which are unventilated, and sulphuretted hydrogen which is always found in sewage, when it has undergone a certain amount of decomposition, is highly offensive and is the most dangerous gas of *known* composition. Mr. Baldwin Latham says that one part of the gas, mixed with two hundred parts of atmospheric air, will kill a horse; one part of the gas, mixed with five hundred

parts of atmospheric air, will kill a dog; and one part of the gas, mixed with fifteen hundred parts of atmospheric air, will kill small birds.

But what the noxious organic vapours are, which are to a certain degree present in all sewers, and constitute their most subtle and dangerous element, has never been determined. It is very certain that they contain neither carbonic acid, sulphuretted hydrogen, nor any of the other gases known to the labaratory. They are either of themselves the cause of disease, or are the medium by which the germs of disease are carried from the sewers in which they float about.

There are persons who believe that sewer gas is not detrimental to health; that is, that it will not produce disease, since these emanations have been known to be present without their evil effect being shown. It is true that many of them, when largely diluted, are innoxious, as was witnessed in London in 1858, when the Thames near Westminster was so offensive, that the subject received the immediate attention of the government; but it is not so much the presence of gases of *known* composition that is so injurious, as the organic vapours and germs of disease, which are carried in the air of sewers and which are ever active to feed or spread disease, until effectually destroyed.

That sewer gas does exert an injurious influence upon health, is the experience of those who have ever given their attention to this subject.

Murchison says:—"I have met with few examples of enteric fever, which upon investigation I could not attribute to defective drainage."

Col. Waring says:—"It is very clear that no system yet applied has been so generally efficient in lessening and weakening the attacks of typhoid fever, as the English system of water supply and *impervious* drainage, which gives drinking water free from contamination, and leaves the air untainted by the decomposition of organic matters in the vicinity of dwellings."

By a reference to the table already given, it will be seen to what an extent the death-rate has been lowered by an efficient system of sewerage, by which the sewer-gas is kept out of houses.

Hart, in his "Manual of Hygiene," estimates the decrease of the death-rate in some portions of England at 75 per cent., due to an improvement in the drainage.

With reference to the particular diseases, which are supposed to be due to sewer-gases, typhoid fever and diphtheria seem to be pre-eminent.

Dr. Fergus, Health Officer of Glasgow, says that in every case in which typhoid fever and diphtheria had broken out in houses, he had always found some defect by which sewer-gas had obtained admission.

Dr. Murchison relates the case of an epidemic of typhoid fever, which broke out in the Boys' School attached to Colchester Union. The boys, who were first attacked and who suffered the most severely, were those who occupied desks, which were placed in the direct line between a passage, in which was an untrapped drain, and the fire. The natural tendency of this gas to seek the warmest air caused it to pass over the desk occupied by these boys, with the above result. Literature is full of just such cases.

In a letter received from Dr. Day, Sanitary Superintendent and Register of New York, he states that diphtheria, in the estimation of the Board of Health, very often co-exists with defective house-plumbing, which allows sewer-gas to enter the living rooms or halls of a house.

Dr. J. S. Cohen, Professor of Diseases of the Throat in the Jefferson Medical College of Philadelphia, writes that, in his opinion, much of diphtheria and typhoid fever is to be attributed to emanations from defective sewerage.

Professor Alonzo Clark, of the College of Physicians and Surgeons of New York, says that "numerous instances are recorded by the Board of Health, in which great fatality from diphtheria has attended a break in the waste-pipe, or the saturation of the earth under the house from the filth of drains."

In Tottenham, England, there are always more deaths from diphtheria when the sewer-gas is confined to the house by closed windows. The medical reporter says that "there *has scarcely been a case of diphtheria in Tottenham, where some serious defect in the house drain was not discovered.*"

The "New York Medical Record" relates the case of a prominent physician, living in an unexceptionable locality, who was attacked with diphtheria. Upon close examination, it was discovered that the soil-pipe from the adjoining house had broken, letting in upon his cellar floor an immense amount of disgusting filth. "It is difficult always to make a careful examination of the premises," the journal observes, "but it seems probable that if each case of diphtheria were carefully investigated, a large number of the so called idiopathic cases might

be traced to some such origin. Many similar cases probably occur to the minds of most practitioners, and there seems to be no reason why such influences as these described, should not, in many cases, be the causes of diphtheria, just as they often produce typhoid fever, puerperal fever and erysipelas—an opinion which is beginning to be very generally held."

The "Sanitary Record," of March 13, 1875, mentions a serious outbreak of diphtheria which occurred at Hornsey, England, which the medical officer attributed solely to the escape of sewer gas into the school-house.

In the prisons of Brest, the rooms, which were supplied with water-closets, were filled with sewer gas, when the southwest wind drove the air through the sewers and forced the traps. In these apartments the cholera raged with the greatest intensity, while those parts of the prison not supplied with closets remained free from it. In our own cities, it is known that the fatal prevalence of typhoid fever, and it is believed that frequent epidemics of diphtheria and cerebro-spinal meningitis, are due to faulty drainage alone.

One great cause of the serious danger arising from sewer gases is, that their *noxious* forms are incapable of being detected by the sense of smell. We can detect very easily the *chemical* constituents of sewer-gas, viz:—the sulphuretted hydrogen, etc., but its presence does not necessarily indicate that the fœtid organic vapors are associated with it; *they* impart no odor by which they can be recognized.

Dr. Simon, in his introduction to his Report to the Privy Council, in 1874, says:—"Whether the ferments of disease, if they could be isolated in sufficient quantities, would prove themselves odorous in any degree, is a point on which no guess can be hazarded; but it is certain, that in doses in which they can fatally infect the human body, they are infinitely out of the reach of even the most cultivated sense of smell, and that this sense (though its positive warnings are of indispensable sanitary service), is not able, except by indirect and quite insufficient perceptions, to warn us against risks of morbid infection."

Our only safeguard is to treat every emanation from a sewer or drain as an enemy; for although it may not, in this or that particular instance, contain the germs of disease, yet it indicates always that there is a direct communication between the sewers and our houses, by which communication the noxious gas may at any time rise.

DISINFECTANTS.

Another fallacy is our dependence upon disinfectants, to render inert the dangerous gases of decomposition. This firm reliance upon them, to the neglect of other more efficient means, is fraught with serious danger. Because we have succeeded in making the air of a room unbearable, by the odors arising from the use of various vaunted disinfectants, it does not follow that true disinfection, in the true sense of the word, has been accomplished. Dr. Simon says:—"To disinfect in the true sense of the word cannot, I apprehend, be proposed as physically possible, and the utmost that disinfectants can do, is to contribute something supplementary to efforts, which necessarily must be of another sort. With reference to houses, which are said to have offensive smells, it cannot be too distinctly understood, that cleanliness, ventilation and dryness are the proper deodorizers, and that artificial deodorizers will no more serve in their stead, than in regard to persons, perfumes would serve instead of soap and water."

A commission, appointed some time since to report upon the sanitary condition of Boston, makes use of these words:—"Any reliance upon disinfectants, as a means of public sanitation, would be but a delusion and a snare."

At the International Sanitary Congress, held in Vienna, in 1874, it was unanimously decided, that there was no agent known, which was certainly capable of destroying contagion, and that therefore we must look with suspicion upon all disinfectants.

Col. Waring says:—"All manner of chemicals, used for disinfecting sewer-gas, are objectionable from their unpleasant odor, their own injurious character, the constant attention they demand, their inefficiency and their expense; nothing has yet been discovered that can at all compare with the simple use of wood charcoal."

It scarcely belongs to a report of this kind to refer more particularly to the subject of disinfectants, but as this subject is so vaguely and indefinitely understood, and as too great a reliance is placed upon them to destroy the products of decomposition and the contagia of disease, any additional light which can be thrown upon the matter may not be out of place.

There are a number of disinfectants in common use, such as Chloride of Lime, Permanganate of Potash, Sulphur, Chloralum, Carbolic Acid, and Proto-Sulphate of Iron (Copperas), all of which possess true disinfecting properties, though in a varying degree.

The disinfectant, which is most commonly used to disinfect a water-closet or a privy, is chloride of lime, which in order to do any good whatsoever, must be used in large quantities (as much as 1633 per cent. of pure chlorine has been found necessary to make any impression whatsoever upon the infective properties of vaccine virus). As however the odor from it is very offensive, its use seems highly objectionable. If used in a room, its odor soon becomes so unbearable that the windows have to be thrown open, and "we have arrived at the minimum of benefit, and the maximum of discomfort."

In carbolic acid we have a substance which arrests decomposition as long as it is used, but, as Pettenkofer says, when it is removed, the ferment cells again become active, and it therefore must be used continuously, and the impure matter be constantly removed. It is powerless as a deodorizer, concealing odors but not destroying them.

In an exhaustive series of experiments on the various disinfectants, undertaken by Dr. Baxter of England, and given in the Report of the Medical Officer to the Privy Council for 1875, it was conclusively shown, that "no virulent fluid could be considered disinfected by carbolic acid, unless it contained at least 2 per cent. of the pure acid by weight."

Aerial disinfection, as commonly practiced in the sick room, is either useless or positively objectionable, owing to the false sense of security which it is calculated to produce. To make the air smell strongly of carbolic acid, by scattering carbolic powder about the floor, or of chlorine, by placing a tray of chloride of lime in a corner, is, so far as the destruction of specific contagia is concerned, an utterly futile proceeding. The use of carbolic vapor should be abandoned, owing to the relative feebleness and uncertainty of its action.

Permanganate of potash has comparatively feeble antiseptic powers, though it will destroy sulphuretted hydrogen gas, "standing half way between the exaggerated value, ascribed to it by some, and the total repudiation of its claims by others." (*Baxter.*)

Dioxide of sulphur, where *aerial* disinfection, as in a sick room, is to be resorted to, seems of all the disinfectants the best; but in order to do any good, the space to be disinfected must be kept under its influences an hour or more.

In copperas, we have a substance, which will not only arrest decomposition, but will also absorb the odor of sulphuretted hydrogen, which gives the vile odor to decomposition. It is therefore especially adapted to water-closets, vaults and urinals, but its property of staining, which is a great drawback, has prevented its general use.

Hydrated chloride of aluminum, a compound, which has been sold under the name of chloralum, is highly praised by many English sanitarians; in fact, it is the disinfectant which has been officially prescribed by the London Board of Trade. It is claimed that, either in its solid or fluid state, it will accomplish just as much as copperas, and is free from the objection of staining. On the other hand, as experiments, undertaken by the Central Chemical Institute of Dresden, seem to show that it has comparatively feeble antiseptic properties, its efficiency must be looked upon, with caution.

Of all the substances, which have as yet been advocated for the absorption of sewer-gas, wood charcoal is the best, since, according to the researches of Prof. Muspratt, it not only imbibes and destroys all offensive emanations, and oxidizes many of the products of decomposition, but there is scarcely a reasonable ground of doubt remaining, that it does really possess the property of a true disinfectant, "acting by destroying those lethal compounds upon which infection depends."

Voelcker says: "It possesses the power not only of absorbing certain smelling gases, sulphuretted hydrogen and ammonia, but of also destroying the gases thus absorbed; for otherwise its purifying action would soon be destroyed."

As one cubic inch of beech-wood charcoal, according to Liebig, contains pores, equal to an area of 100 superficial feet, a very small piece is sufficient to destroy a large amount of organic matter; and from its great power of renewing its oxygen, to which it owes its ability of destroying organic matter, from the atmospheric air, the same charcoal can be used for a long time. "In fact," says Dr. Stenhouse, "the efficiency of charcoal seems never to diminish, if it is kept dry, and its pores are not choked with dust." The only

precautions to be used with it is, that it should be kept from the rain, and air shall have free access to it.

As the moisture of sewer-gas (as was proven in a paper on the absorption of mixed vapors by charcoal, read by J. Hunter, Esq., before the Chemical Society of London, in 1870,) proves the efficiency of charcoal, it seems peculiarly adapted to the destruction of this gas. Its only disadvantage is that it requires special contrivances for holding it, and a free access of air, which would be difficult, under certain circumstances, of providing.

Of the disinfectants which have been previously mentioned, carbolic acid, copperas, and possibly chloralum, seem to be the most efficacious, and for aerial disinfection the dioxide of sulphur. To do any good, carbolic acid must be constantly used in large quantities, and every precaution taken, especially in the case of children, that it is not mistaken for something else and eaten.

For the disinfection of clothing, bedding, rooms, etc., dry heat, when freely applied and brought into contact with every particle of matter to be disinfected, is the very best, since moisture favors the propagation and diffusion of disease germs, but dryness retards this action.

It should be remembered, however, with all the disinfectants, used for the purification of a sick room, that before one-tenth part of the amount, capable of destroying the disease germs has passed into the atmosphere, it will become unfit to breathe. They are valuable, after a patient with small-pox has been removed from the room or house; of use also to destroy the germs contained in the sputa of diphtheria and the excreta of typhoid fever, when applied directly to the discharges themselves, but entirely valueless in destroying these germs, while the patient remains in the room; for the amount necessary to accomplish this purpose would also destroy the patient.

In their most useful forms, they are simply adjuncts to other means; in others they render the air unfit to breathe, and in all forms, they engender a false sense of security, which may result in sickness and death, not only to individuals but to communities.

CHAPTER III.

SEWERS.

That this sewer gas not only will, but does find its way easily through many channels into our houses, to affect the health and lives of the occupants, cannot for a moment be doubted. It has often been noticed that stoppages of sewers in large towns, whereby the gas becomes more forcibly compressed, coincide with an outbreak of disease in those houses, whose drainage has been affected by this stoppage.

The ready facility with which sewer gas finds its way into houses is explained by its singular lightness, which causes it to ascend, and to be drawn to the highest temperature; and as in the cool months of the year our living and sleeping rooms are made warm for comfort, these rooms are the very ones, to which the gas is naturally attracted. So great is this tendency of the gas to rise, that it has been often noticed that houses, situated upon a hill, are more unhealthy than those situated in the valley, the foul air ascending to them through the drains.

Thon says, that in Cassel, in the higher part of the town, which one would suppose the healthiest, typhoid fever was brought into the houses by sewer gas which rose to them by reason of its lightness. In Oxford, in 1850, cholera, by the same action, appeared in several houses in the higher and healthier parts of the town.

From the direct relation, which has been shown to exist between sewer gas and disease, from its subtleness, from our inability to recognize its noxious properties, except from their result, from the ease with which it forces its way over almost every barrier into our houses, to work out its mission of destruction, this whole subject becomes one of vital importance, not only to sanitary bodies, but to every community and every individual in it, and should demand their earnest attention.

In order that the proper means may be employed for preventing the injurious effects of these gases, it will be necessary to ascertain what are the defects in the sewerage of a town, which permit the noxious vapors to escape.

These defects consist either in absence of all sewerage facilities, or in the existence of sewers which are defective in construction.

In the former case, privies and cesspools become matters of necessity; and the slop waters are either thrown directly upon the ground, to soak into it, or to stagnate more or less, or pass into open surface drains by the public ways, to give off in both cases the gases of decomposition to pollute the atmosphere, particularly if the unsewered locality should be low, damp and illy ventilated.

It has often been assumed that sewers may be dispensed with, when there are no water-closets in use, and that sewers are only needed where they are intended to carry privy filth; and that for the mere carrying of slop water, the open wayside channels, which are designed for rain water, will amply suffice. This assumption can only rest in the ignorance of what these slop waters are, in relation to the filth contained in them. "They are always quick to undergo decomposition, sometimes poisonous the moment they are discharged from the house," and constitute such a fertile source of sewer gas, that the night soil is not especially marked, save as a specific vehicle for spreading such epidemics as are communicated by bowel discharges.

Corfield says: "Any one, who has examined the sewers of Paris, Lyons, or any other town where the sewers do not convey matters from the water-closets, knows perfectly well, that they are just as offensive, just as foul in every way, as they are in the most thoroughly water-closeted town."

"Quick as these fluids are to give off the gases of decomposition, they are slow to cease this process. They retain for weeks enough material to generate their gaseous poisons, which are inhaled to the great detriment of health."*

Still the flow is kept up day after day, and week after week, until the premises and localities become strongholds, from which disease in various forms sallies out to attack the community.

Such refuse at its worst is a very condensed form of sewage, and even at its best, it cannot be allowed to remain without danger, whether it soaks into the soil or is carried off by surface drains.

* Dr. Winsor, in Massachusetts State Report for 1875.

Typhoid fever has been abundantly proven to be a disease of the undrained portions of towns. Such is the report from all parts of the world. In Dantzig "it is entirely confined to the unsewered districts." In all the reports from the Medical Officers of Great Britain, the connection between many diseases, particularly typhoid fever, and absence of drainage stands out pre-eminently. This is but one example from many :—Dudley, (Worcestershire). Endemic scarlatina, typhus, enteric fever and diarrhœa; defective and insufficent sewerage; polluted water and private wells; insufficient excrement and refuse disposal.

The connection between diphtheria and insufficient drainage has been shown to be very close; numerous opinions upon this point have already been given, and we cannot avoid the conclusion, upon contemplation of the many facts adduced in support of this theory, that it is certainly a "filth disease."

That the history of the late epidemic of diphtheria in this city confirms this view cannot be doubted. Up to the end of July the greatest mortality from this disease was upon the East side of the River, in localities where the drainage was deficient, and where decomposing matters were found giving off gases upon the premises. The first case of death occurred in January, upon St. Clair Street, in a house which had no connection with the main sewer, the slop waters, etc., being thrown out upon the ground. Several cases occurred upon Payne Avenue, where there is no main sewer and consequently the drainage is very defective. In March, three deaths occurred in a house on Muirson Street, where the drain connection had been completely stopped up, and the occupant had turned the hydrant water into his privy, which in consequence had overflowed and deposited its offensive matters upon the ground.

In the months of February, March and April, a number of deaths were reported in the lower portions of Commercial and Forest Streets, in the neighborhood of the Canal, where there was at that time no drainage whatsoever.

During the month of November, three deaths occurred in a house upon Dodge Street, which had been reported to be in a good sanitary condition. Upon careful inspection, however, it was discovered that under the room, in which the children were accustomed to play, there was no cellar, and foul damp odors were often noticed in the apartment.

The epidemic, which occurred in the Atwater Block, in September, which was seemingly due to a broken drain under the house, letting sewerage matters escape, has already been mentioned.

In August, the mortality commenced to be greatest upon the West and South sides,—notably in the 10th Ward, where there is no drainage whatsoever, and where the surface water, on account of the clay soil, cannot soak into the ground. In some portions of this Ward the sub-soil water is but a few feet below the surface, and in consequence there is much dampness. Slop waters are thrown out upon the ground to give off noxious gases, or are led into cess-pools with the same results.*

In September and October there were a large number of deaths in a locality upon the South Side, in the 13th Ward, bounded by Jennings and Seranton Avenues, and Auburn and Fairfield Streets. In this locality there is no sewerage, and the well water was found to be badly contaminated by privy filth.

A number of deaths occurred upon Herschel Street, in the 13th Ward, in November; but here again there is no sewerage, the houses stand upon a hill-side, and the wells in consequence receive the leakage of the privies above them. A number of these wells were examined and their waters found to be polluted.

The same thing is true of the many cases which occurred in the neighborhood of Pear and Fir Streets, where no sewers exist, and where the water from the wells was found contaminated with privy filth.

During the whole year there occurred in the twelve Wards upon the East side of the River (including Newburgh), which have 61.6 miles of drainage, 193 deaths from diphtheria; while in the six Wards upon the West and South sides, with only 11.79 miles of drainage, and with only 50,000 inhabitants, there were 202 deaths from this disease. In other words, there was a percentage of deaths, per 1000, upon the other side of the River, of 4.04; while upon the East side, there was only 1.75 per cent. per 1000.

In the early portion of the Winter, a serious epidemic of this disease visited West Cleveland. In this village the drainage is very imperfect, the ground is damp, and the sanitary conditions generally bad.

* In this Ward there occurred 82 deaths from diphtheria, being 54 more than occurred in any other Ward in the city.

In short, out of the 395 deaths which occurred from this disease, during the past year, less than 75 cases occurred in houses having any drainage, while not one of these 75 occurred in houses which was efficiently protected against the invasion of sewer gas.

Out of the 331 different houses, in which this disease occurred, only 51 had any sewerage advantages whatsoever.

Apart from the consideration of these diseases, there are others, growing out of the relations already pointed out, which exist between certain diseases, such as consumption and malarial diseases, and deficient drainage. How close this relation is, in the case of consumption, can be learned by reference to the following table, showing the decreased rate of death by consumption by an improved system of drainage :—

REDUCTION IN RATE OF CONSUMPTION.

Banbury,	41	per cent.
Cardiff,	17	"
Croydon,	17	"
Dover,	20	"
Ely,	47	"
Leicester,	32	"
Macclesfield,	31	"
Merthyr,	11	"
Newport,	32	"
Rugby,	43	"
Salisbury,	49	"
Warwick,	19	"

The condition of the districts lying about Rome is an example of the effects of drainage upon malarial disorders. For centuries these districts had been highly malarious, until Tarquin built his splendid system of drains, when malaria almost entirely disappeared. Coincident with the decay of these drains malaria became rife, and at the present day is very common.

Shawneetown, Ill. was formerly so malarious, that one-half of the men, building a railroad there, died. Since the construction of a drain, however, this region has been very healthy.

It must also be remembered that soil dampness, a condition which exists to a great extent in the 10th Ward, where so many cases of diphtheria have

occurred, is thought by many eminent men to be an important factor in the production of diphtheria, *particularly when this dampness is associated with an impervious sub-soil.*

On the contrary, the death-rate, as has already been shown, is materially decreased by a good system of drainage.

In Croydon, England, the death-rate has been lowered in twenty years 40 per cent. by improved and extended drainage, and in Liverpool it has been reduced from 38.4 to 26 per cent. by sanitary improvement.

With these facts before us, with a knowledge of the improvement of health and the decrease of the death-rate, caused by a good system of sewerage, I would call the attention of your Honorable Board to the large territory within the City limits, which is totally without sanitary works of any kind, and which in this respect is little better than a country village. There are portions of the city, notably in the 8th, 10th, 11th and 12th Wards, which are very damp from the amount of water, which is habitually present within a few feet of the surface, and in some districts actually flooding the cellars of the houses. Newburgh also is totally deficient in drainage works, and owing to the crowded condition of some portions of it, this deficiency is, in a sanitary point of view, badly felt.

As well as some portions of our city are drained, there is certainly a great need for an extension of the system, since I am very confident that the lack of good sewerage which now exists in many wards, has a direct bearing upon the health of this community. The death-rate of Cleveland is certainly low, when compared to other large cities.* But this is accounted for by its situation upon the borders of a large lake, whose breezes sweep over the city, giving it a large amount of pure air, and also by the smallness of its population as compared with the area which it occupies.† With these natural advantages, the death-rate, as low as it is, ought to be much lower, which it can be made under an improved system of drainage.

A due consideration is being given to this subject all over the civilized world. The sanitary condition of London, Paris, Brussels, Hamburg, Dantzig and Frankfort-on-the-Main, in Europe, and of New York, Brooklyn,

*It is 19.90 per cent. for 1876.

†Twenty-six square miles, or five more than New York with a population of over a million.

Chicago and Providence, in this country, has been so improved by the introduction of efficient sewerage, that Berlin, Stuttgart, Munich and St. Petersburgh, in Europe, and Boston, in America, are turning their attention to the same subject. Cleveland, a city unusually favored in its location, a great commercial centre, destined to be one of the largest cities of the West, a city in which much has been done already for sanitary reform, cannot afford to be behindhand in this necessary work.

I believe that there is no class of improvements, for which property owners would be more willing to pay, than for a supply of pure water and good drainage, since these absolute necessities bear such a close relation to their health. Even if individuals do not care for their health—and many seem to attach less importance to this than they do to that of their horses and cattle—yet, looking at the subject in its financial aspect, no one can afford to disregard his health in any way, since no one can *afford* to be sick.

Taking the English calculations, which are very low for America, as a guide, we find that the 3,227 deaths, which occurred in Cleveland last year represent a money loss of $2,355,710.

In Massachusetts it has been estimated that the loss to the State, from the sickness of working people alone, is over $15,000,000 annually, and that the same reckoning, for the entire population, would be over $40,000,000. Taking into consideration the deaths from preventable causes alone, it is computed that there would be an annual saving to Massachusetts of $8,181,840, if these preventable diseases were to be removed by the proper sanitary measures.*

Mr. Baldwin Latham, at his inauguration as President of the Society of Engineers, stated that there had been a mean saving of 2,439 lives in thirteen years at Croydon, owing to sanitary improvements, which would represent the following saving of money:—

	£	s.	d.
2,439 funerals at £5 each,	12,195	0	0
2,439 × 25 = 60,975 cases of sickness prevented, at £1 each,	60,975	0	0
† 1,317 value of labor at £19, 10s, for 6½ years,	166,929	0	0
	£240,099	15	0

*The calculations, upon which the above results are based, are the allowance of two persons constantly sick for every one who dies, or 730 days of sickness annually. That this is low, may be judged from the fact, (according to Dr. Boardman), that in 1872 one from every eleven patients died in the New York Hospitals, and in those of Great Britain and Ireland, one out of every nine. The value of labor is estimated at an average of one dollar per day.

†He estimates that of the 2,439, six tenths would be above 20 years of age, and of these, one-tenth would be infirm from age, which would leave 1,317 persons in full vigor of life.

Although the original works cost £195,000, they have caused a saving of £240,000, which in the thirteen years would be a saving of a sum, exceeding by 25 per cent., the total expenditure of the works.

Consequently in whatever way this important subject is regarded, whether from a consideration of health or wealth, an *efficient* system of drainage becomes a necessity, and as such it should be looked upon by the proper authorities.

FAULTY CONSTRUCTION OF SEWERS.

As necessary as sewers and drains are to health, equally important it is, that they should be thoroughly and scientifically built; otherwise they create a sense of security, which they do not at all warrant, and which they will most assuredly betray, to the detriment of our health and well-being.

It has been said that demerits in existing sewers can in some essential respects be judged by common observation. As the object of a sewer is to prevent stagnation of filth in and about houses and frequented places, and to guard against a dangerous pollution of air and soil, which the filth, if not effectually carried away, must occasion, so of course any sewer, which itself occasions any such stagnation and pollution is in proportion as it does so, unsuccessful, and a sewer, which emits a foul odor at its points of ventilation, is just so much evidence of such unsuccess. The *sine qua non* of success in a sewer is :—first, that the flow of sewage to its outfall shall, as completely as possible, be continuous and complete, and scouring, not ponded, leaking nor depositing; and secondly, that the sewer should be perfectly ventilated. A sewer in which these conditions are fulfilled will scarcely, if at all, under ordinary circumstances, cause appreciable odors at open (untrapped) gullies in the street; the air in it, if compressed, will not easily exert at the duly guarded inlets of house drains any such pressure as can make way for it into houses; and in cases where accidental defects of house drains unfortunately permit sewer air to enter houses, the sewer air will be at its lowest degree of dangerousness.

These being the requisites of a good sewer, the practical question for us to determine is whether our own sewerage fulfills all these requirements. Some of them it does, but in many of these it absolutely fails: wherein them defects in my estimation consist, I beg leave respectfully to point out.

OUTLET OF SEWERS.

It is almost an axiom, that no sewer, if it can be avoided, should discharge in the direction of the prevalent winds, since by their agency the sewer gas will be forced back through the sewers and house drains connecting with them, directly into the dwellings, unless a most efficient system of trapping and ventilation is provided to prevent it.

Unfortunately for the well being of this community, most of our sewers necessarily open to the North, from which the prevailing winds blow in the Winter season, sometimes with a velocity of twenty-five or thirty miles an hour; consequently the sewer gas is driven through our unventilated sewers into the houses, which, without this ventilation, nothing, not even the most effectual trap, will prevent. This is a serious evil, and one to which I would draw particular attention, since it has become a nuisance which should be immediately remedied.

That the sewage should be discharged under water, as has been advocated by some, seems to me highly objectionable, since thereby the contents of the sewers would find but a difficult exit, and becoming stagnant, would give off a large amount of noxious vapors. Under the present circumstances, there are but two plans, which can be suggested,—either the erection of a suitable screen, at a proper distance from the outlets of the sewers, to break the force of the wind, or the placing upon their mouths what is known as a flap or tankard valve, which consists of a metal cover, hinged to the upper arc of the circle, so that by swinging outwards it will permit the ready escape of the sewage, but falling back by its own weight, it will prevent the entrance of the winds. This latter plan, which is the one strongly recommended by many distinguished American and English Engineers, is an excellent one, provided that the hinge could be kept from freezing, which in our climate would be extremely doubtful. The screen, therefore, seems to be the most feasible means which could be employed, although it would necessarily confine to some extent the sewage, which when recent floats in water, within the area which it bounds.

VENTILATION OF SEWERS.

Intimately connected with the preceding subject is that of sewer ventilation,—a subject which has for a long time been pre-eminent in the minds of all sanitarians. That sewers and drains should be thoroughly ventilated is at the

present day no longer a question, since a system of sewerage, which is unprovided with the proper means for preventing an escape of sewer gas into dwellings, is imperfect in the extreme.

Eassie, in his work on "Healthy Houses," says that all theories of drainage, which fail to inculcate the *absolute* necessity of ample ventilation of sewers and drains, are worse than useless; they are even dangerous.

Parkes, in his "Practical Hygiene," says: "That no sewer is air-tight is certain, but the openings, through which the air escapes, are often those which we least desire. It is therefore absolutely necessary to provide means of exit of foul and entrance of fresh air, and not to rely upon accidental openings. The air of the sewers should be placed in the most constant connection with the external air, by making openings at every point where they can be put with safety."

Wilson (Hand-book of Hygiene and Sanitary Science) says: "In order to prevent concentration or stagnation of the gases, which are largely given off by sewage, it becomes a matter of the utmost importance to provide numerous openings, communicating with the sewers, to ensure free ventilation."

Hart (Manual of Public Health) says: "That the absence of any ventilation (in a particular case referred to), was the cause of a severe outbreak of fever, has been demonstrably proven, since the fever subsided immediately upon the proper ventilation of the sewers, although previously it had been domiciled."

Dr. Carpenter writes to a similar effect: "That it shall not be possible for stagnant air to be ever present in any part of a system of sewers."

Mr. Rawlinson, a distinguished English Engineer, says: "Persons comcomplain that foul smells arise from sewer or drain ventilators, and stop them up or cry out for this to be done, forgetting that the escape must be somewhere, and most probably into the houses of those who complain. That foul air smells come from ventilators is the best proof that ventilation was and is required; the true remedy will not be to stop up one, but to form a second, third, and so on, until by dilution and dispersion at several points, as far assunder as practicable, concentration in a sewer or drain is prevented and the sensation of smell ceases."

Baldwin Latham (Sanitary Engineering) says: "If ventilation is not provided, as every drop of water passes into a sewer displaces an equal volume

of sewer gas, if a safe exit is not provided for it, it will escape at points out of control and where least expected." * * * "Unventilated sewers are far more dangerous than steam engines without safety valves; they contain in their air some quality, which is pestilential and dangerous to health, and this can be disposed of or neutralized, only by giving the air of the sewer a free connection with the air."*

As a practical result it was found in Croydon, (which now possesses one of the most perfect systems of sewerage in the world), that typhoid fever, which occurred periodically, was very frequent, and increased in one year the death-rate from 18.13 per cent. to 28.57 per cent. per 1000. Diseases, which were formerly confined to the lower portions of the town, were carried by the sewers to the upper portions. *After the sewers had been thoroughly ventilated* there was no further outbreak of typhoid fever, although the population had been doubled, and the death-rate now seldom rises to 18 per cent., "a standard of health unparalleled in the history of sanitary science by a district having so large a population."

From the numerous quotations from distinguished sanitarians, which have been given, it can readily be understood how important this subject is, and how defective is a system of sewerage, which fails in giving the proper ventilation to its sewers.

The necessity for this ventilation arises both from the great lightness and diffusibility of sewer gas, which in consequence naturally seeks the highest outlet of escape, unless other vents are provided for it, and also by the compression and expansion of the air within a sewer. This latter result is caused by its temperature being raised, either by the objectionable practice of letting waste steam escape into these sewers, or by the discharge into them of hot water from factories, or from the wash stands, bath tubs and sinks of dwellings.

The increased amount of pressure, which is produced by an elevation of temperature, may be readily learned by the following formula: Letting 1,036.7 represent the volume of air in cubic inches, at a temperature of 50° F., and 1,240.8, that at 150° (the temperature of sewers before and after the admission of hot water), and 14.6 lbs. per square inch, or a column of water 34 feet high, the original atmospheric pressure, we have 1,036.7 : 1,240.8 : :

*Parent DuChatell found that an *unventilated* sewer in Paris contained but 13.79 per cent. of oxygen; while a *ventilated* sewer in London contained 19.51 per cent. Atmospheric air contains 21 per cent.

34 feet : 40.7 feet, an increase of pressure of 6.7 head of water, caused by the increase of temperature. This is an increase of pressure, which no trap can resist; and hence the necessity for ventilation.

The compression of the air in a sewer is also caused by a sudden influx of water into it, either from a rain storm or from the usual waste of a house. If the amount of water, thus admitted, is sufficient to fill the sewer three-fourths full, where it had been previously running only one-half full, the air which originally had occupied the remaining half of the sewer must be compressed into one-quarter of the sewer, which would increase the pressure upon the air by an amount equal to a column of water 34 feet in height. Of necessity this pressure will be relieved either by an escape of the air through proper ventilators if they exist; otherwise through the various openings into our houses.

When the volume of water in the sewers is again reduced, or a condensation of air in them has been caused by a lowering of their temperature by the admission of cold water, or by cooling after the hot water has passed off, a vacuum is produced which causes atmospheric air at the rate of 1,330 feet per second to be drawn in; and this alternate exhalation and inhalation of air is what constitutes the proper ventilation of sewers.

Other forces likewise contribute to the ebb and flow of air in the sewers, such as barometric changes—wind blowing over the tops of the ventilators, and the law of diffusion of gases.

When proper vents are provided, by which the air of sewers may find a ready escape, and through which atmospheric air may be taken into them, the outfall of a sewer in the direction of the prevailing wind will be to a certain extent beneficial, but without proper ventilation, an obstacle to the passage of these winds *must* be provided. Even with ventilators, if the wind should blow forcibly into the sewers through their outlets, rapid currents are produced in the sewers, which escape too quickly through the ventilators, and therefore must be controlled by some such appliance, as has already been mentioned.

The practical remedy for this evil, arising from improper ventilation, is of course the provision of proper ventilation. If our living rooms contain vitiated air, our first object usually is to give it an egress, and to allow fresh air to flow in; if our sewers contain polluted air, (sewer gas), our first object *should* be to devise means for its removal; that is, for ventilation. We cannot

expect the sewers ever to be free from gases, but our aim should be to prevent these gases from mingling with the air we breathe in our dwellings.

The best method of accomplishing this purpose, and the one advocated by the most careful observers, is to furnish the necessary ventilation through the man-holes in the middle of the streets. In order that this may be accomplished, it is necessary that the covers of these man-holes should be perforated instead of being solid, to allow the gas to find a ready exit, and through which atmospheric air may be taken into the sewers, to dilute the vapors which are always found in them. This is the method which has been strongly recommended by Latham, Parkes, Waring and others, and one which is extensively used in all the best systems of sewerage, both in Europe and America.

Ventilation by this method is perfectly harmless, no evil results having ever been known to follow from it: on the contrary, many cases of disease (as witness the epidemic of typhoid fever, which broke out at Windsor, England, and the increase of the death-rate of Croydon,) have been directly attributable to a neglect of this precaution. In many fever hospitals, it has been noticed that there has been a decrease of contagion, when drains have been ventilated, and in some, where certain diseases have been spread, it has been immediately pronounced to be due to imperfect ventilation.

Paris ventilates her drains through the street gullies, without any detriment to health. London sewers are ventilated by gratings, opening directly into the streets, and certainly her death-rate for such a large city is very low.* Liverpool has a system of ventilation by means of three thousand pipes carried up through the roofs of houses. "There have been but one or two complaints of bad odors from them, in which cases they have been removed." Dantzig, which possesses one of the most modern systems of sewerage, ventilates it by free openings into the streets. Brooklyn and Providence are the only cities in this country, where free ventilation is obtained by openings into the streets. Many of these gratings have lately been examined by a Commission, and very few only found where any smell whatsoever could be detected six feet from the surface of the street. "There is very seldom any complaint made of them, and very many people fail to discover that they exist at all."

Granting that these openings may become offensive, (of which however there is not the slightest need), how infinitely more so, how much more detrimental

*London stands at the head of large cities by reason of its small death-rate.

to health would it be, if no ventilation existed, and in consequence the sewer gas should be discharged into our dwellings through the various openings in the water-closets, basins, and bath tubs, located, as it so often happens, in close proximity to, and some of them actually in the sleeping rooms. Worse still would this be in the Winter season, when, from the exigencies of our climate, all the windows must be closed, and imperfect means for ventilating these rooms furnished. It is therefore far preferable that the sewer air should escape into the streets, where it may become freely diluted with atmospheric air, rather than into dwellings where no such dilution can possibly take place.

In order that this ventilation should be thorough, these vents should be located one hundred yards apart, or eighteen to a mile; certainly not less than two hundred yards apart.* In the more crowded portions of the city, where the sewers are more liable to carry larger amounts of organic matters, these distances should not be so great, since there is a greater accumulation of gas to pass off, and consequently more vents would be needed. When there is any connection between localities on a higher and lower level by a sewer, there should be in the lower portion more vents provided, since, owing to the lightness of sewer gas, there is a constant tendency for it to rise to the higher portions; for this reason, also, it is very desirable that these sewers should be provided at every outlet with a light flap valve, which, though it would not obstruct the ready passage of the sewage, would cause the gas to escape by its own ventilator, and no undue portion of it be carried by its lightness to the ventilators higher up.

By these means, if a sufficient number of such ventilators were provided, the odor from any one of them would be scarcely perceptible, particularly in wide streets; if any offensiveness should be marked, the remedy is not to close up the vents already existing, but to provide more of them; since under these circumstances more are needed, to give the proper amount of ventilation. In order to still further diminish any possibility of offensive smell arising from these vents, it has been proposed to place in them charcoal in trays; but in many places where this device has been used, it has been abandoned, since it was thought the charcoal interfered with perfect ventilation. It may be stated as an objection to these man-holes, acting as ventilators through their

*In London there is a ventilator at intervals of from one hundred feet to fifty yards.

grating covers, that in Winter they would become useless from being blocked up with ice and snow. This is very true, if they did not receive careful inspection by men, employed not only for this purpose, but for the *systematic* examination of all parts of our sewerage system. I believe that the appointment of such a corps of sewer inspectors would add materially to the usefulness of sewers and drains; no one can over-estimate the importance, which well built and well managed sewers are to health, and consequently the close attention, which should be given to them. They cannot take care of themselves without becoming a nuisance.

It was at one time proposed (and many cities adopted the plan) to ventilate the sewers and drains by means of the rain water pipes from the gutters of the houses. But this method has been found not only impracticable but dangerous; since just when ventilation is most needed, viz:—in heavy rainfalls, when the sewer gas is greatly compressed by the sewers running nearly full of water, these water pipes are likewise full, and consequently are entirely inoperative as ventilators for the passage upwards of the gases from below.

That these pipes cannot be depended upon solely to furnish ventilation to main sewers, is evident from the fact that, when the sewers are running very full of water, the entrances into them of house drains are generally below the level of the water, and consequently the air in the sewer becomes compressed to such an extent, that it soon acquires enough power to force a passage through channels, the least expected. For this reason ventilation of sewers by *any* ventilator, connected with a house drain leading into the sewer, is at many times ineffectual; and street ventilators must therefore be provided for the purpose. Then too the rain water pipes are objectionable, on account of their opening at the eaves of the house, which may be in such close proximity to windows in the same house, or in that of a neighbor's, that the gas carried off by them will find its way into the dwelling.

That these pipes used for this purpose are dangerous to health has been abundantly proved by many instances. The drain of the U. S. Marine Hospital at Chelsea, Mass., was formerly ventilated by means of the water pipes, leading from the eaves trough; during one Winter the water in it froze, and as a consequence the pipe burst in the neighborhood of a sleeping apartment. Two brothers of the Surgeon-in-charge, who occupied this room in the following Summer, died of typhoid fever,—a result which was attributed to

the escape of sewer gas through the leak in the pipe into their sleeping apartment.

Dr. Carpenter, of Croydon, mentions the following somewhat similar case:— For many years his soil pipe had been carried up through the roof to act as a ventilator, and opened close to a large rain water cistern. "On the night of October 17th," he says, "I was aroused by a loud noise proceeding from the water-closet, which continued at intervals throughout the next day." Upon examination, he discovered that the soil pipe had acted as a discharge pipe to the cistern, which in consequence of a heavy rain had overflowed. As it was therefore full of water, it could not act as a ventilator to the sewer to carry up the gas beyond the roof, which, finding no ready exit, forced itself with great violence through the water-closets. The nuisance continued three days, during which period, owing to a continued rain, the windows could not be opened for sufficient ventilation of the house. "Two or three days afterwards one of the occupants of a room, the farthest in the house from the water-closets, fell ill with symptoms of typhoid fever, and in a few days the other person, sleeping in that room, also showed signs of the disease. No other person in the house suffered from it. Into the room occupied by these two persons, the foul air from the closet, as proved by experiment, naturally ascended."

In Croydon, previous to 1860, the sewers had been ventilated by small pipes, particularly at their heads. In this year, however, a law was passed, compelling ventilation by means of water pipes; whereupon the death-rate commenced to steadily increase from 16.63 per cent. in 1861, to 21.26 per cent. in 1865. Upon the repeal of the law, and the ventilation of the sewers by openings in the streets, the death-rate commenced immediately to fall from 21.26 per cent. to 16.6 per cent. in 1869.

CATCH-BASINS.

Complaints are often made that the catch-basins emit an offensive odor, and consequently it has been requested that they should be rendered so tight by more efficient trapping, that no gas could escape from them. To do this with our present system of *unventilated* sewers I deem inexpedient in the extreme, since, owing to the compression of the air in the sewers, it must be forced out at some opening; and if the opportunity for this is removed by effectually closing all street vents, the sewer gas must be necessarily compelled, by the

compression which it receives, to seek an outlet by the various openings inside our houses.

Therefore, as offensive as it may be to have a catch-basin by the side of the street act as a ventilator to the sewer, it is infinitely less hazardous, in the absence of all other street vents, to allow the sewer gas to escape by these catch-basins into the open air, by which it may be largely diluted and rendered innocuous, than to have it forced into our houses, where it can be but feebly diluted, especially in Winter, and where it will sooner or later cause an impairment of health. If a catch-basin at any one point emits a large amount of offensive gas, it is a sure sign that there is something wrong in the sewer, into which the catch-basin discharges; either that, owing to faulty construction, it allows its filth to become stagnant,* thereby giving off large amounts of noxious gas, or that it has not been properly ventilated. The remedy is not to close the vents through the catch-basins, so as to thereby force the sewer gas into houses, but to provide efficient ventilation in the middle of the streets, by which the offensive vapors may find the necessary outlet, and through which atmospheric air may be carried in, away from close proximity to the houses; and to prevent the accumulation of organic matter in the sewers, either by systematic flushing, or by constructing such as will fulfill their objects.

The evil effects of trapping catch-basins, without a system of ventilation, was so marked in London some years ago, that the municipal authorities were compelled to provide vents for the gas in the middle of the street, where it could escape and become diluted farther away from passenger traffic. If such a system of ventilation could be established in our city, an efficient and thorough trapping of the catch-basins should be enforced, in order to prevent any gas escaping from them, since under no circumstances whatsoever, except under those just mentioned, should they serve as sewer ventilators.

To depend upon water traps to prevent the passage of sewer gas is fallacious, since water will readily transmit gaseous bodies, particularly when they are compressed, absorbing them at its lower surface and giving them off at its upper. Apart from this, no water trap is safe from being emptied either by evaporation, or by being siphoned out by pieces of woolen material getting into them, or by the water flowing into the sewers to fill the vacuum caused by

*Sewage must be carried off entirely within two or three days, since before this time, though offensive, it is not dangerous: afterwards, however, decomposition sets in, and it becomes injurious to health.

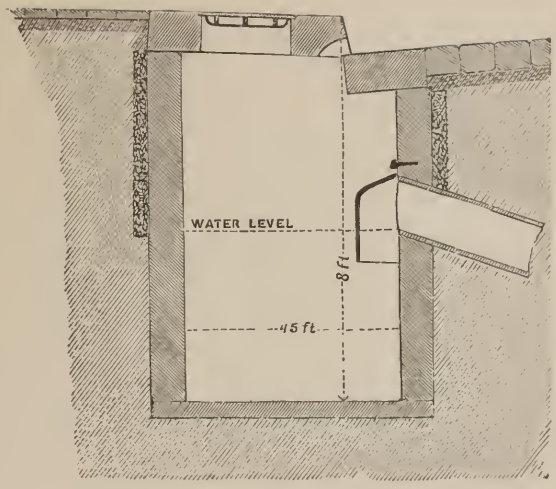

FIG. 1.

SECTION OF CATCH-BASIN SHOWING TRAP IN PLACE.

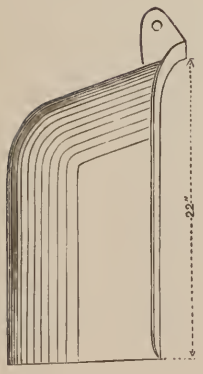

FIG. 2.

SIDE VIEW OF CATCH-BASIN TRAP.

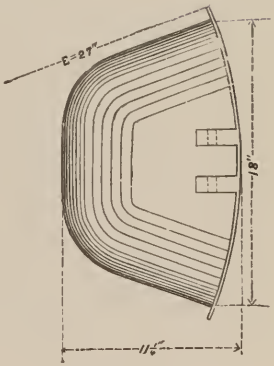

FIG. 3.

TOP VIEW OF CATCH-BASIN TRAP.

Plate I.

the condensation of their gases. Practically the same thing happens when the catch-basins are cleaned out, which sometimes leaves them entirely unprotected until the next rain fall fills them again.

Therefore whenever catch-basins are trapped, which, as has been stated, is an objectionable practice in the absence of other ventilation for the sewers, some other trap should be provided than that furnished simply by water. The one, to which I desire to call your attention, is the one used in Providence, R. I., the arrangement of which is shown in Plate I.

This trap is made of cast-iron, except the pin which forms a hinge, that being of composition. After the plate is built into the brick work, a bed of mortar is laid upon the side of the catch-basin, into which the trap is pressed, making a tight joint. The joint can be broken and the trap lifted at any time, if it becomes necessary to get convenient access to the chute.

Owing to the ease with which bulky substances, such as sticks, paper, rags, cloth and other solid refuse of the streets are carried into the catch-basins, I would suggest that gratings be placed over their openings, to obstruct the passage into them of all such refuse, as has been mentioned above.

In connection with this subject, I beg leave to respectfully call your attention to the present method of cleaning the catch-basins, viz:—by bucket and shovel, which is objectionable both on account of the pollution of the air and ground in the vicinity, which this process occasions, and also on account of its expense. A better method, and one which I would recommend to you, is the pumping out of these receptacles by the pneumatic process, which removes the refuse of vaults, cesspools, catch-basins, etc., by forcing it through a pump into an air-tight receiving tank, provided with an deodorizing attachment, without vitiating the ground or atmosphere. As the 49th Section of the Health Ordinances provides that *all* receptacles, containing fluid or semi-fluid filth, shall be emptied by means of such an apparatus or process, I would recommend that its provisions be immediately enforced in respect to catch-basins as well as privy vaults, especially as thereby at least $2,000 can be annually saved to the city.

SIZE AND MATERIAL OF SEWERS.

Upon this subject I enter with some hesitation, as I make no pretense to a knowledge of engineering: but as I am confident that much harm has been done by mistakes committed in this direction, I desire to briefly call attention

to the subject, in order that, if it may be necessary, such mistakes in the future may be avoided.

The object of all sewerage is to carry off organic matter as rapidly as possible, in order that, by a speedy removal, there shall be no opportunity for it to stagnate, and, by its decomposition, to give off noxious vapors. Even in the best constructed sewers, sewage will adhere to some extent to their sides, particularly if built of brick, and consequently there is greater need that they should be built of such a size as to be as self-scouring as possible.

The great mistake, which is committed in all cities, is that of not building the sewers proportionate to the probable demands of the future. Large enough for the scattered population at the time of their construction, they soon become, with the growth of the city, entirely inadequate to the more densely populated areas, which they are supposed to drain; consequently, as they soon get choked with the sewage which they cannot carry off, they become little better than elongated cesspools. The dangers, arising from such an accident, were forcibly illustrated a few years since in that part of Euclid Avenue, which lies between Erie Street and the Square, where, as previously mentioned, owing to the inadequate size of the sewer, and in consequence defective drainage, several cases of diphtheria and typhoid fever occurred.

On the other hand, a mistake is sometimes committed in the opposite direction, viz:—that of building sewers too large; for although sewers should always be built to meet the requirements of the future, yet if they are built to do more than this, they are defective. As it is a well-known fact, that a stream of water will run more rapidly through a narrow channel than through a wide one, so sewage will be more rapidly and effectually carried off by a small drain, provided it is large enough for its work, than by a large one, in which, owing to the sluggishness of the flow, sewage would soon become deposited, and gradually accumulating would render it unserviceable.

Some time since an experiment was made upon the Earl Street sewer in London, which was three feet wide and had a sectional area of fifteen feet, with an average fall of one in one hundred and eighteen, and destined to receive the drainage of twelve hundred houses of an average size. The solid deposit in this sewer accumulated to the amount of six thousand cubic feet per month (two hundred and twenty-two cart loads). A fifteen inch pipe placed in the sewer, with an inclination of one in one hundred and fifty-three, and the

sewage directed through it, was found to keep perfectly clear from deposit. The average flow from each house was about fifty-one gallons a day, and, apart from rain fall, it was estimated that the twelve hundred houses could have been effectually drained by a five inch pipe. A similar experiment was made in the Upper George Street sewer, which was five and one-half feet wide. In this sewer a twelve inch pipe, five hundred and sixty feet long, was placed, and the sewage directed through it. It was noticed that sand, trees, bricks, mud, etc., thrown into it, were carried through rapidly, and discharged into the sewer twelve feet from the end of the pipe, but there remained, unable to be carried further on account of the size of the sewer, and consequently the sluggish current. "*The pipe was rarely observed to be more than half full at its head.*"

Not long ago a sewer of three feet in diameter was built in Saratoga, which, besides its usual population, has six large hotels, containing nearly one thousand people each, when full; and one of which holds thirteen hundred guests and servants, and contains one hundred water-closets, thus necessitating a large use of water. The town is also widely spread out, and its topography is such, that rain water runs off very rapidly, and yet, when every available water supply from the hotels, houses, and from a rapidly running brook was turned into the sewer, there were but nine inches of flow in it. When a full head of water from a hydrant was let in, it only succeeded in raising the flow one inch at the upper end, and less than one-half inch at the lower; and with a heavy rain storm, the flow was raised at its highest point only two inches.

It may be said, with justice, that a sewer constructed of an egg or horse collar shape, as is now the custom when it is built of brick, would always be proportionate to the amount of sewage to be carried off by it, and no matter how small the amount of this might be, it would find a relatively small channel in which to flow. This is very true, but if smaller egg shaped sewers, or smaller ones of a different shape or material, would be large enough to meet all future demands, would it not be economy to build them, thereby saving the expenditure, which the larger ones would entail?

The sewers of Paris have often been quoted as being the model sewers of the world; but, built originally for the rapid and secret transporation of troops,

underground, they are used now principally for surface drains.* So disproportionately large are they† for the amount of water which flows through them, that $145,000 are expended every year upon a length of two hundred and seventeen miles, to keep them clean, and necessitating the employment of twenty-three officers and four hundred workmen.

On the other hand, although the old sewers in London were in such a state of ruin in 1865, and so choked with filth that their refuse had to be removed by shovel, yet in spite of the great expense attendant upon this process, their size was so much nearer what is required for the ordinary flow of sewage, that it cost only two-fifths as much to keep them clean as it did the sewers of Paris.

Objection may be made to small sewers, upon the ground that they will not carry off the rain water, for which an allowance of one inch fall in an hour, with one-half reaching the sewer during the fall, is made in determining their size. But this allowance seems to be in many instances too great, since, from observations carefully made in Providence during the last forty years, it has been found, that, out of three hundred and twenty-four recorded rain storms, but eleven fell at the rate of one inch or more an hour. In Cleveland during the past year, out of the one hundred and sixty rain storms, there were but nine of one inch or more per hour.

Mr. Bazalgette, Chief Engineer to the Metropoliton Board of Works of London, says that, during the past twenty years, there have been on an average in that metropolis one hundred and fifty-five days per annum, upon which rain fell: of these there were only about twenty-five, upon which the quantity amounted to a fourth of an inch in twenty-four hours. It is therefore a question, whether it is wise to expend large sums of money in the construction of sewers of sufficient size to meet these rare emergencies of great rain falls. "Not only are smaller sewers sufficient to carry a given rain fall by reason of the loss by absorption, evaporation and other causes, but also on account of the length of time required for the water to reach the sewers. That, which falls near the outlet, runs through the sewer and escapes, before that falling at a distance has reached it." (*Shedd.*)

*At the present time, however, fifteen hundred houses discharge their drains into the sewers.

†The smallest section ever built was 5 feet, 6 inches high, by 2 feet 3 inches wide at the springing of the roof.

I do not forget that the size of a sewer should be proportionate to its inclination, in order that a proper velocity of the current should be attained, or that a small sewer (*other things bei g equal*) requires a greater fall than a large one. It is very true, as is stated by works upon sewerage and drainage that the velocities of a ten foot sewer, with an inclination of two feet per mile, of a five feet sewer, with an inclination of four feet per mile, a two feet sewer, with an inclination of twenty feet per mile, are equal. *But in order that these velocities should be equal, (and this should never be forgotten), the ten feet sewer must carry one hundred times the amount of sewage; the five feet sewer, twenty-five times, and the two feet sewer, four times as much as the one foot sewer.* Hence it becomes very necessary, in order to secure the proper velocity to make the sewer self-scouring, that to the size of it must be given the same attention and consideration as to its inclination. Consequently a large sewer should not be laid in a district with a slight fall, unless, to prevent its becoming a sewer of deposit, (which it would undoubtedly become, even when, running full or half full, its rate of inclination would give the required velocity to make it self-cleansing), we are sure of a volume of sewage which would fill the sewer to an extent, sufficient to maintain the velocity required, (not less than two feet per second), either naturally, or artificially by flushing arrangements.

Upon this subject the well-known engineer, Col. G. E. Waring, writes as follows:—"The passion for too large pipes seems to be an almost universal one. The feeling is that it is best to make a conduit "big enough anyhow," and as a result, nearly every drain that is laid, in town or country, is so much larger than is needful, that the cost of keeping it clean is often the most serious item of cost connected with it.

"It was estimated that twenty-five years ago the mere house drainage of the whole of London might be discharged through a sewer three feet in diameter; yet there is probably not a village of five thousand inhabitants in the United States, whose magnates would be satisfied with a sewer of much less size for their own purposes; and a single hotel in Saratoga has secured future trouble, in the way of the accumulation of raw material for the production of poisonous sewer gas, by laying a drain for its own use thirty inches in diameter.

One principle is very apt to be disregarded in regulating the sizes of sewers; that is, that after water has once fairly entered a smooth conduit, having a fall or inclination towards its outlet, the rapidity of the flow is constanly accelerated

up to a certain point, and the faster the stream runs, the smaller it becomes: consequently, although the sewer may be quite full at its upper end, the increasing velocity soon reduces the size of the stream, and gives room for more water. It is found possible, in practice, to make constant additions to the volume of water flowing through a sewer by means of inlets at short intervals, and the aggregate area of the inlets is thus increased to very many times the area of the sewers itself. *Where a proper inclination can be obtained, a pipe eighteen inches in diameter makes an ample sewer for a population of ten thousand, and even with a slight fall, a well constructed eighteen-inch pipe sewer is ample for the drainage of an ordinary village area, containing seven or eight hundred houses.*

"In Tottenham (England), a main sewer of nine-inch pipe, widening to twelve inches and afterwards to eighteen inches, and having a fall of only one in one thousand and sixty-two, drained an area containing sixteen hundred houses. Its ordinary current was two and one-half miles per hour, and brick-bats introduced into it were carried to the outlet. During ordinary continued rains it was not more than half full, half a mile from the outlet, and at the outlet the stream was only two and three-fourths inches deep.

"It was formerly the custom with architects and engineers to enlarge the area of any main pipe or sewer, in proportion to the sectional area of each subsidiary drain delivering into it. But this is no longer done, since it has become known that additions to the stream increase its velocity, so that there is no proportionate increase of its sectional area."

MATERIAL USED FOR SEWERS.

Without presuming to discuss the comparative merits of the various materials used in the construction of sewers, since the subject does not belong especially to this department, yet I am confident, that if it can be shown that pipe sewers will fulfill the object of good sewerage just as well, if not better than brick, they could be laid, on account of their comparative cheapness, in many portions of our city, which might otherwise be deprived of the requisite drainage.

The advantages which a good sewer, made out of the British or American vitrified, salt-glazed pipe possesses, in my mind, over brick, for those districts, where a smaller sewer will suffice, are, that its inner surface is smooth, and therefore less liable to have organic matter attach itself to its sides; is less

likely to leak, and can be more cheaply built and kept clean. On the other hand, a brick sewer cannot be made smooth on the inside; is always offensive even if small, since the bricks (unless with extraordinary care in their selection), will be porous enough to absorb the filth in the contents of the sewers, and are very liable to leak and hence pollute the soil. In Frankfort, the sewers were built of the very best brick and cement, and yet Pettenkofer found that water had leaked into them, before the sewage water had been allowed to enter.

E. S. Chesbrough, City Engineer of Chicago, a well-known authority on scientific sewerage, after a visit to Europe in 1856–'57, as Chief Engineer of the Sewerage Commission, made the following report in 1861 :—

"It seemed evident to us, that, if properly constructed, and not applied to drain too large areas, pipe sewers might be safely adopted. The experience of five years confirms this opinion, and shows that they not only cost less money than large brick sewers would have done in the first construction, but are likely to cost materially less in maintenance."

The Croton Aqueduct Board use the following language in their Report, dated January 3d, 1870 :—

"The system of sewerage which has been adopted by this Board was recommended by the former Chief Engineer, Mr. Craven (after an experience of nearly twenty years as Chief Engineer of this department), and was determined on only after a careful study by him of the systems advocated and adopted in Europe, and especially in London, where the subject of thorough and economical drainage had been extensively discussed and experimented on. It has worked well where it originated, and has, as far as we have experience, without exception, worked well here.

"The Board are perfecting and extending the new system as fast as a just economy will allow, and correcting the old arrangement of sewers, which were built without their control, and without any harmonious plan.

"The cost of brick sewers, as built under the old plan, would be about three times that of the pipe sewers, which are their efficient substitute.

"In the matter of cleaning and repairs, the discrepancy is still greater.

"There are now upward of sixty miles of the pipe sewers in operation in this city. Instances of failure have been extremely rare, and in all cases

they could be traced directly to unfaithful construction on the part of contractors—a contingency from which no works are exempt.

"The cost of repairing all of these defects in sixty miles of this sewerage has not exceeded $3,000; and for cleaning, and removing obstructions, for the past year, the cost has not exceeded $500.

"There are 261 miles of brick sewers in the city, for which the cost of cleaning, and removing deposit, for the past year, has been $27,730; showing that, while the extent of the brick sewers is only 4⅓ times that of the pipe sewers, the cost of cleaning has been more than fifty times greater."

In 1871, the cost of repairing and cleaning these pipes was, to that of brick sewers, in the proportion of 1 to 34 $\frac{61}{100}$; in 1868, it was 1 to 24 $\frac{18}{1000}$.

No surer test of the capacity of these sewers could have been applied than the effects of a rain fall, which occurred in a certain October, when four inches of rain fell in five hours, which was rapidly and effectively carried off by the pipe sewers.

Another advantage which these pipe sewers possess, is that they can be built much smaller than brick, on account of there being less friction in them.

Five-sixths of the pipes in New York are not more than twelve to eighteen inches in diameter. In Brooklyn, one of the best-drained cities in the country, one hundred and twenty miles are only one foot in diameter, and seventy-eight miles, fifteen to twenty-four inches in diameter.

In Chicago, where the grade is said to be, on the whole, more nearly level than in almost any other city in this country, there are fifty-three and one-half miles of pipe sewers of only one foot in diameter, a small amount fifteen inches, and about fifty-five and one-half miles two feet.

As pipe sewers are extensively employed, at the present time, throughout the country, I would respectfully call your attention to the experience of other cities in their use, and recommend that their merits may be duly considered in the future drainage of our city.

INVERT BLOCKS.

To the subject of invert blocks for sewers I desire to call the attention of your Honorable Body, since I believe that all sewers, whether built of brick or pipe, should be provided with a separate channel of some sort for the

drainage of the subsoil water. For, although through a porous soil this water will percolate, following the line of the sewer, yet, if it is at all impregnated (as it is very liable to be) by the liquid refuse of the streets, vaults or cesspools, it will pollute the water of any well or spring which it may meet in its course.

No sewer should be built of such a porous material that it could be depended upon to drain off subsoil water; for a drain which will admit into it this water, will permit the escape of its sewage, with the certain effect of contaminating the soil.

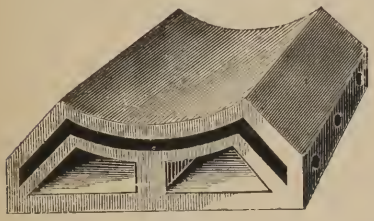

Fig. 4.
Invert Block.

The invert, a diagram of which is annexed, is made of a material, glazed and vitrified upon its upper surface which forms the bed of the sewer, but is porous upon the sides, to admit the ingress of the water to its channel.

Another advantage to be found in an appliance of this kind is, that where sewers are constructed through a district which abounds in sub-soil water, it serves to drain off this water, thereby preventing its coming into contact with the cement before it has had a chance to set.

FLUSHINGS OF SEWERS.

There are many sewers in this city, which from faulty construction, from being too large or too small, from not having inclination enough, or from some cause, do not fulfill the necessary requirements of good sewerage; that is, their contents stagnate and decompose. Whenever this is the case in any sewer, it is an absolute matter of necessity, that this deposit should be carried off by an artificial flow of sufficient depth to thoroughly scour the sewer. This may be accomplished by flushing, either directly from a hydrant, or indirectly by means of a dam or reservoir, or both combined; and I would respectfully suggest that one or the other of these means be employed more thoroughly than at present, to keep these sewers free from a noxious deposit.

In connection with this subject, I beg leave to call your attention to the sometimes erroneous practice of introducing into a district a copious water supply, before efficient sewerage has been provided. This is irrational, since

with a plentiful water supply there is more water used, and as a consequence, the increased drainage from the house will speedily cause an overflow of the old receptacles, such as cesspools, (if any), or will flow on the ground, in either case causing an additional moisture and dampness of the ground, and an increased pollution of the air and soil.

To the vast importance of this subject I beg leave to call the attention of your Honorable Body; and in view of the fact that there are many parts of our city inefficiently drained, by reason of the small size of the sewers, and many other sections which have no drainage facilities whatsoever, I would recommend at some time not far distant, the appointment of a commission, to carefully examine into our whole sewerage system, and to report upon the advisability of largely extending it, and of improving it in such particulars as may be deemed necessary.

In particular, I desire to suggest to you the great necessity, which exists, for immediately providing some form of drainage for certain districts in the 8th, 9th and 10th Wards, which, by reason of the large amount of sub-soil water existing near the surface, are rendered exceedingly damp. If sewers cannot be built at the present time, at least sub-soil drains should be laid to carry off this water.

CHAPTER IV.

HOUSE DRAINAGE.

As important as the consideration of the public sewers is, equally, if not more important, is that of house drainage; since, by this system the interior of dwellings is brought into direct communication with the main sewers, from which sewer gas will escape into living rooms, unless the house drains are properly constructed and efficiently ventilated and trapped. How seldom this occurs; how infrequently the proper attention is paid to the construction of house drains, even by those who ought to understand this system, is well known to every one who has ever investigated this subject. Over and over again houses are built, even in the very best portions of all cities, elegant in inside finish, provided with all modern luxuries and conveniences; the interior richly decorated and ornamented, with every device to please the eye; and yet, as far as the health and well-being of the occupants are concerned, miserable failures on account of the imperfection in their drainage, which, faulty in design and execution, is pretty sure sooner or later to cause sickness.

Some observations made by Major-General Cotton, in a lecture delivered by him before the Society of Arts in London, upon "The Construction of House Drains," may perhaps awaken householders to the dangers to which many of them are exposed by their imperfections:—

"During the last year," he says, "there has been an entire disregard of all the first principles of sanitary science, shown by the builders of many new houses. There are comparatively few, who realize the daily loss of health, even by the well-educated classes, from breathing contaminated air. The weak link of our drainage system is the house connections; and the only way to obtain security is a thorough alteration in the policy hitherto adopted. House drainage should be supervised by the sanitary authorities, in the same way as the main drainage is. It is well known that many of the best houses in

London, owing to the gross ignorance of builders and house owners, are most unhealthy and dangerous places to live in. Houses by hundreds are being built in all parts of London, and in other large towns, in which every sanitary law is neglected. These home truths would perhaps be more thoroughly realized, if all the diseases produced by sewer gas were classed together under the head of "drain fevers."

What is true of London, is true of every city in America. In New York, the physicians attribute the greater portion of the sickness there to bad drainage. One can scarcely go into a house in that city, writes a correspondent, (and the same might be said of many such houses in Cleveland) which has "all the modern conveniences," without detecting an odor from the drain pipes. In an elegant Fifth Avenue mansion, and occupied by one of the wealthiest ladies in New York, the smells emanating from the water and waste pipes are at times almost insupportable. An examination of the house revealed the fact, (and it is an example of the carelessness or ignorance of those who ought to know better) that the main soil pipe ran directly up into the third story of the house, where it was plugged with an iron cap. All the various waste pipes from the different stories were led into this main pipe. Inserted through the cap, which plugged the end of this large pipe, was an inch pipe which ran to the garret, where with a curve it entered the tank, from which the whole house received its supply of water. It was thus intended to act as a waste pipe for the overflow of the tank. But in reality it acted as an escape for the poisonous gases from the soil pipe, which, by its aid, found a vent in the water destined for domestic use.

The whole literature of disease is full of incidents in proof of serious results arising from defective house drainage. In every letter, which has been received by me from prominent physicians in the Eastern cities, where the subject has been mentioned, defective house drainage has been given as one of the chief causes of diphtheria.

Dr. E. H. Janes, Assistant Sanitary Superintendent of New York, and Lecturer on Hygiene, writes that, where diphtheria has occurred in that city in the better class of houses, it has very often been associated with defective plumbing.

Dr. W. DeF. Day, Sanitary Superintendent of the same city, writes that this disease very often co-exists with defective house drainage, which allows sewer

gas to enter the living rooms or halls of a house. "There is no doubt in our minds here," he says, "that the bad sanitary condition of a house furnishes a proper soil for diphtheria."

At the present time one of the most prominent physicians of New York is treating, in an elegant house near the Windsor Hotel, four cases of diphtheria and one of erysipelas all of them directly traceable to the foul gases generated in the water pipes and drains of the house.

The following case, reported by Dr. C. F. Folsom in the "Boston Medical and Surgical Journal," is given at length, on account of the instruction to be derived from it:—

"Mr. ——— lives on the slope of a hill about twenty feet higher than the level of its base, in the farther half of a double house. The neighborhood is a favorable one to health, and the occupants of the houses are intelligent and of the upper class. Mr. ——— himself has read much of the so-called sanitary literature of the day, and is a gentleman of wide general information.

"There have been three cases of severe illness in his house; one (fatal) of diphtheria, one of scarlet fever, and one of typhoid fever, all occurring at nearly the same time. In the last case, the patient had slept in the adjoining half of the house on account of the diphtheria in his own half, and was taken ill immediately upon his return home. There was also one case of typhoid fever in the house directly opposite.

"These cases all occurred before the recent impurities in the Cochituate water had been observed, and the three houses referred to are the only ones connected with the sewer, running down the street on which they are situated.

"External to them, there is some low land upon which one case of typhoid fever occurred; but I think that the influences which might produce disease there were too remote to effect the houses which we are now considering.

"Mr. ———'s house is well-built and there are many arrangements for ventilation, etc., which show that the owner has thought of and tried to provide everything that is necessary to promote the health of the inmates. The faults of construction are many. Upon careful examination of the furnace, it was found that the heated air supplied to the dining-room during the day (from which it was shut off to warm the entry on the second floor at night) really came from the cellar and not from the external atmosphere. The air of the

cellar, too, was liable to two sources of contamination beside the ordinary ones: first, the house-drain passed directly under its floor, and secondly, the floor of the vegetable-cellar, although well cemented, was four feet lower than the level of the water in a catch-basin for the surface drainage in the yard, at a distance of only ten feet from the wall. (This catch-basin has since then been made as impervious as cement will make it.) The house-drain is very liable to be obstructed by grease, the sink having the ordinary bell-trap, with a 'goose neck" in the leaden pipe in the cellar. The drain was of glazed earthenware. The water-closet in the cellar was entirely unventilated except by a small window, which is closed during the winter months. The water-closet in the second story was in the centre of the house, and entirely unconnected with the external air except by a square wooden "ventilating shaft" running from the ceiling out through the roof. The soil-pipe had not been continued to the roof, and there was no ventilation in the proper sense of the word. In the back entry, there was a window in the roof, which served for ventilation in fair weather. The stairway, leading up to the third story, formed a direct channel of communication from the furnace-register, from the water-closet, and from a wash-basin, also in the entry, to the chamber where the most severe illness occurred, while a more indirect line existed from the water-closet in the basement up the back stairs, the heated and lighter gases following a natural law to reach the highest point accessible. The chamber in which the less severe cases occurred were subject to the same influences, but to a less degree, as they were on the second story and therefore not so high. The water from the roof was discharged into the sewer by trapped pipes. A sewer about six hundred feet long and at a steep grade had been built in 1869 from the main sewer on ——— Street and ending opposite Mr. ———'s house *without a man-hole or any means for inspecting or flushing*, not even the water from the street serving the latter purpose. The main sewer on ——— Street, too, joined another from ——— Street, which latter conveyed a large amount of sewage of an especially putrescible character from a large establishment near by. Added to this, the two man-holes, at the two points of junction referred to, had large catch-basins underneath them and in the bottom of the sewer, which were always necessarily full of the worst kind of sewage; and, as if that were not sufficient, the sewers at this (the lowest) point, in case even of such a moderate rain as we had a few weeks ago, were entirely inadequate to carry off what was

put into them, and sewage was actually forced into the adjoining houses through the water-closets (*not* those in the cellars.) At this low junction is the bulb of the retort where the gases are manufactured, free to pass up its neck into the three houses, that in which the most illness occurred being at the very top.

"It is easy to see that an elevation of two degrees of temperature within the sewers, or a heavy rainfall, will cause a pressure which no traps or series of traps can resist. Had it not been that one—the lowest of the houses—had connected its rainwater spouts with the sewer without traps (an arrangement which is often not without serious objections, but in this case one of the best things that could have been done, as it served to protect in a measure three houses) the results would probably have been even much worse than they were.

"I was asked what should be done. There certainly was a complication of evils. No matter how carefully these gentlemen used their wealth and intelligence to perfect the sanitary arrangements of their own houses, there was a condition of things external to them, and which they were utterly powerless to remedy, which, to say the least, it was not pleasant to look in the face."

Dr. Bowditch reports an instance of erysipelas, spinal meningitis, scarlatina, rheumatism, sore throat, quinsy, inflammation of the heart with convulsions, and typhoidal pneumonia, occurring between December and the following June in one family, who lived in a large house, situated upon the southern slope of a hill. This long list of affections he attributes to ill arrangements of the house, *defective drainage*, *sewage obstruction* and dampness of the cellar; at least, since these defects have been remedied, the family has been perfectly healthy.

Sir Sydney Waterloo, formerly Lord Mayor of London, a gentleman well known for his researches into sanitary matters, two years ago lost eight members of his family by diphtheria,—"a penalty I paid," he said, "for being a wealthy man, and having in my house, all the modern conveniences which, when it was too late, I discovered were defective."

Dr. Mapother, of Dublin, an eminent sanitary authority, states that there occur annually in England 140,000 cases of typhoid fever, of which 20,000 terminate fatally, which are clearly traceable to defective drainage and sewer gas poisoning.

Under these circumstances, it is much better that there should be no connection whatsoever between the house and the main sewer, but all sewage should be

thrown out upon the ground ; for seriously objectionable as this practice would be, yet on account of the dilution which the emanations from the sewage would receive from a free admixture of atmospheric air, it would be much less dangerous, than though these matters were thrown into a drain, through defects in which by means of the washstands, bath tubs, water-closets, etc., the sewer gas, undiluted, could find its may into our living and sleeping rooms.

Although the proper construction of house drains, both inside and outside the premises, is so important to our health, it is singular what a lamentable amount of ignorance is displayed, and what little attention is given to the subject, not only by householders, but by those, who, the community have a right to expect, should be experts in all the details of house construction. It is a subject in which each individual is directly interested independently of his neighbor, and independently of the public sewers, since no amount of care nor skill, in constructing these sewers, will relieve him of the necessity of using the same care and skill in building his house drain ; particularly as these drains will often cause by their faulty construction more trouble than all the rest of the sewerage system.

"The work of house drainage," says Mr. Baldwin Latham, "is the crowning point of a system of sewers. Upon the care and skill bestowed in carrying out this portion of the sanitary requirements of a district, in a great measure will depend the ultimate success of the works, in a sanitary point of view. It cannot be overlooked that imperfect sanitary works in connection with the houses in which we reside will, in the malarious influences of the sewers and drains, be brought to bear directly upon their occupants. As a rule, the works of house drainage are carelessly and thoughtlessly carried out, and often inflict untold injury on the luckless occupants of the house, in which they are executed. It should be said that the train of evils, which often follows the improper execution of house drainage works, is not due, generally speaking, to the character of the workmanship, but to faults in principle in the arrangements adopted."

Happily householders everywhere are becoming aroused to the realization of the dangers which have menanced them from defective house drainage, and are seeking means for their prevention. These remedies have been found in some instances, both in public and private dwellings, in placing no reliance whatsoever upon the efficiency of the drains, but in giving up, as completely as

possible, all avenues by which sewer gas could escape into the rooms. In many modern built houses no stationary washstands are found outside the bath room; in some not even a stationary bath tub is allowed, but safety is procured in the safer, if less convenient, bowl and pitcher and "hat-tub" of our ancestors. This is certainly a move in the right direction, if perfection in house drainage cannot be obtained; for with imperfectly constructed drains, these modern conveniences, including the water-closet, are but paying a heavy premium for disease; since it is impossible, no matter how well the outlet of these washstands and bath tubs are plugged up at the bottom, to close the overflow holes in the sides, through which the vapors from the drain will escape. Under no circumstances should any one of these appurtenances be permitted a single second in, or in close proximity to sleeping apartments, since, as dangerous as it is to inhale these noxious gases in our vigorous moments of wakefulness, it is infinitely worse to be brought under their influences during the relaxation of sleep, when the system is more impressionable to morbid surroundings.

The proper remedy, however, consists in striking at the very root of the whole matter, and making use of a proper and scientific system of drainage both inside and outside our houses. Such a system is one which fulfills the object of all sewers and drains, viz:—to carry off from houses all liquid refuse, waste water and foecal matter continuously and rapidly, without allowing them to stagnate and decompose, and, while performing this duty, to be so designed and constructed as to effectually prevent the admission of sewer gas into the house.

These objects are best accomplished by using for drains outside of houses the vitrified salt glazed stoneware, or fire clay pipe, to which reference has already been made, on account of its smooth surface, its durability and its non-liability to leak if properly constructed and jointed. The proper precautions should invarably be taken, when these pipes are laid in "made ground," to secure them against the possibility of breaking, if the soil settles.

Wooden drains are worse than useless; they are exeeedingly dangerous, since they induce a false sense of security, and hence lead to evil results when least expected. They are almost always out of order; very frequently broken down, and thus allow a ready escape of their contents. If this break or leak should occur under the house, the sewage would find its way through the foundation walls of the house or upwards through the cellar floor. "Not one wall in five

hundred," says Mr. Philbrick in his Report upon House Drainage, "will stop this; neither will concrete cellar floors. The more resistance there is offered to the influx by such walls and floors, the more the filth is accumulated in the surrounding soil by lapse of time and constant leakage from the cracked drain, till the clean porous gravel with which the street was once filled becomes saturated with the sewage,—a sponge of an uncertain extent, filled with the foulest matter, which it is next to impossible to shut out of the cellar, for it is both fluid and gaseous."

The epidemic of diphtheria, which has already been related as having broken out in the Atwater Block, is an example of how much mischief a wooden drain may create. A similar case is reported by Dr. Whittier of Boston, where a broken, leaking wooden drain seemed to have been responsible for four deaths from diphtheria which occurred in a house, in which the year before there had been six cases of scarlet fever.

As for brick drains for houses, I believe that for reasons which have already been mentioned, they do not serve their purpose nearly so well as a pipe, being false in principle, and wasteful in the cleansing, construction and repair.

The size of these drains and their inclination is likewise a matter of great importance. Since some of the drains are built too large, (as very often happens from mistaken ideas), the flow is not rapid enough to cause the requisite amount of scouring, and consequently stagnation of the sewage is the result. In order that the proper amount of velocity (not less than three feet per second) should be attained, the least inclination that should be allowed for a four-inch drain is one in ninety; one in one hundred and thirty-seven for a six-inch drain; and one in two hundred and six for a nine-inch drain, running half full. But as the house drain seldom runs half full, practically it will be necessary to secure a greater fall than the minimum mentioned—perhaps two in a hundred for a four-inch drain, or one and one-half per hundred for a six-inch drain. In other words, a four or six-inch pipe will, under ordinary circumstances, be sufficient to drain quite a large house.

All right angles, whether in vertical or horizontal junctions of drains and sewers, should be avoided, since they tend to produce eddies and delay in the transmission of sewage. These junctions and connections should therefore be made in such a way that the incoming current should flow as nearly as possible in the direction of the one which it meets. This is accomplished

either by what is known as a Y joint, or by making the connection on a curve of sixty feet radius.

Another mistake, which is sometimes committed, is that of entering the house drain at too low a point into the main sewer. This is objectionable, since its outlet will often be covered by the water in the sewer, thereby preventing a proper ventilation.

House drains should never, if possible, run under the house, but should get *outside* as soon as practicable; since, if they should ever leak, the sewage and gases would be discharged underneath the house, and nothing would prevent the effects of this leakage being perceived through the floors.* "It is better," says Eassie, "if they have to run under the house, owing to its construction, that they should be laid either on top of the cellar floor, or suspended under the ceiling, so that leakages may be speedily detected and remedied."

SOIL PIPES.

For the construction of all drains inside the house walls, metal of some sort should be used, though earthenware pipes have been employed for this purpose. Mr. Latham says that *pure* lead pipe, drawn or cast, but not soldered, is the best for soil pipes; but I understand that the experience of engineers, in this country, has not justified them in following his advice. Lead is very liable to be injuriously affected by the action of sewer gas, which leads to its corrosion and perforation, through which—no matter how small—the noxious vapors will escape, to vitiate the atmosphere. Dr. Fergus of Glasgow says, in his Report on the Sewage Question, that good lead pipes will ordinarily last, when thoroughly ventilated, for twenty-one to thirty-three years; but when unventilated, for only ten to twelve years. Cases have been reported, however, where they have worn out within three months after they have been introduced into the house. Owing to the liability of lead pipes to leak, those made out of *cast* iron, with well-leaded, calked joints, seem to be preferable, since there is but little danger of their leaking, unless subjected to great changes of temperature.†

It cannot be too well understood that drains of all kinds within the house should be so placed that they can be readily inspected, in order to remedy all

* Menzies says that sewer gas has been known to pass through floors and walls two feet thick.

† Soil pipes should be four inches in diameter.

defects as quickly as possible. This becomes very necessary, since serious sickness has often occurred from leakage of sewage from house drains, which have been so covered up that discovery of the leak has been rendered impossible without great trouble and expense.

Dr. Fergus, in the Report just mentioned, writes as follows upon this subject: "The practical sanitary conclusion, which it concerns us all to keep in mind, is, that any house—no matter how carefully or well built—may become unhealthy from this source; and that when cases of typhoid fever, diphtheria, etc. occur, the pipes should be thoroughly inspected, especially their upper surface, and the whole of the soil pipe uncovered. I must strongly insist on this, as in many cases the plumbers have declared pipes to be all right, which turned out to be very defective when uncovered. For some years back, I have insisted on a careful examination of the soil pipes, wherever I have had cases of typhoid or diphtheria; *and in every case where I could get this thoroughly carried out, I have detected these perforated pipes, or sewer gas getting into the house in some other way.*"

If any leak in the drainage pipes of a house is suspected, a very simple experiment will be sufficient to detect it. Pour an ounce or two of the essence of peppermint, one of the most valuable and certain agents for this purpose, into any receptacle, such as the washstand, connected with the suspected pipe, and let a gush of water fall upon it and carry it through the pipe. If there is any leak, no matter how slight, its existence will be made manifest by the strong odor of peppermint in the apartment or sewer near where there the imperfection has occurred.

The discharge pipes from basins, tubs, sinks, etc., through which nothing but waste water escapes, can be made of lead, which under these circumstances is not liable to corrode, but possesses the advantage of being easily bent into any shape desired.*

TRAPS.

A very important part of the system of house drainage, and one but imperfectly understood, is that of traps. These are obstacles, usually of water, which are placed in the line of the drain to prevent as far as possible the free passage

*Two inches are recommended for the size of discharge pipes from sinks if they are short, and one-inch for basins, bath tubs, etc., which discharge comparatively clean water.

of sewer gas into the house. They are very important, particularly where the defects in the main sewers already mentioned exist.

To be effective, however, they must be properly constructed; otherwise they become traps indeed, thoroughly disappointing any reliance which may be placed upon them. One of the best forms of traps for house drainage is the S shaped, or water trap as shown in Fig. 5 E., which, to perform its functions, must be deep enough, according to Parkes, to allow water to stand in it at a depth of not less than three-quarters of an inch above the highest level of the water in the curve.

The place where a trap will be of the greatest service is outside of the house in the main house drain, after it has received all its connections. This trap is very important, since without it the sewer gas would ascend to force some one of the smaller and weaker traps above. To be sure, many smaller traps of this kind might be contrived at various points in the soil pipe above; but this would be objectionable, since every departure from a straight line in the construction of a conduit necessitates a greater delay in the passage of its contents. "The rule, in fact should be," says Parkes, "that the union of any pipe with the outside drain should be broken both by water and ventilation." * * * "It is hardly possible to insist too much upon the importance of this rule of disconnection between house pipes and outside drains. The simple plan of disconnection, if properly done, would ensure persons against the otherwise certain danger of sewer air entering the house. Houses, which have been for years a nuisance from persistent smells, have been purified and become healthy by this means."

A neglect of this simple precaution of trapping outside of the house was said by the leading physicians in England to have been the cause of the dangerous attack of typhoid fever, from which the Prince of Wales nearly lost his life at Lownesborough Lodge a few years ago.

The following case of national importance is also illustrative of the evils growing out of untrapped drains:—

In the spring of 1857, a number of strangers came to reside at the National Hotel, Washington, to be present at the inauguration of Mr. Buchanan, as President of the United States. A large number of them, including the President elect, were seized almost at the same time with enteric fever. It

was reported that they had all been poisoned; at first it was said with arsenic, for some political purpose; and then by coffee, from the culinary utensils. A vigorous investigation ensued; and the result was, that both the committee for this purpose and all the medical attendants coincided in the belief that the disease was due to sewer gases. At one part of the building there was *a direct* opening into the sewer, and through this a strong current of fetid air was distinctly perceptible. The fever first appeared after three very warm days, during one of which the rain fell in torrents. The sudden rise of the river Potomac, into which the sewer opened, was thought to have driven back the noxious vapors through the gully hole.

In England, this disconnection is sometimes made by a receptacle placed in the ground just outside of the house, from which a ventilating pipe rises to carry off the gas. This practice, however, is objectionable, from the possibly close proximity of the windows, into which the gas in summer might penetrate, and also from the likelihood of the tank freezing in severe winters. A much better method is to introduce a pipe trap (B, Plate II)—which is practically nothing more than a depression in the pipe itself—of the same sectional area as the pipe, into the drain. At the point in the drain where the trap is constructed, (just outside the house walls), it would be advisable, in all land where there is danger of settling, to place a man-hole, in order to inspect the drain, to detect any break which may have been caused by this process.

One of the most common causes of obstruction in the house drain arises from the grease, which when hot is fluid, but which when cool becomes solid, and gradually collecting in the drain, surely closes it up. Drains, thirty to fifty feet in length, have been entirely closed up by this cause. In consequence of this, it is always objectionable to allow the discharge from the kitchen sinks, or from any house appurtenance into which greasy water is liable to be thrown, to connect directly with the drain. This can be prevented in one of two ways: either by placing an S trap in the discharge pipe under the sink, provided with an opening closed by a rubber stopper, such as is now sold, by which the grease can be cleaned out of the trap; or, still better, by making use of a regular grease trap under the sink, as recommended by J. Herbert Shedd, Esq., City Engineer of Providence, and shown at E, Plate II. The joint between the body and the cover is effectually sealed by rolling up a lump of clay, about three-quarters of an inch in diameter, with

a string through the middle, for convenience in handling, and laying it in the groove with which the cover is provided, when the cover will compress it so as to make a tight joint, which can be conveniently broken when necessary. Another variety, advocated by Col. Waring, is made of well-cemented brick work, and made perfectly water tight. It is placed just outside the house, and can be ventilated by a grating in its cover, if it is not too near a window. A rain-water spout may be discharged into it, which would help cleanse it.

A house drain, which has been properly constructed, does not require a catch basin; but if, from lack of a sufficient fall, or from being too large, or from any other cause, the flow through it is sluggish and stagnant, then an opening in the line of the drain is advisable, through which it can be cleansed by wires, or scoops, or by flushing.

In addition to the trap outside the house already mentioned, every waste pipe from a water closet is also provided with one, usually with a siphon, or S trap, (E, Fig. 5), filled with water, as a security against the admission of gas through the bowl of the closet; as well as all sink pipes, and discharge pipes from wash basins and bath tubs, (provided the latter are of unusual length, say ten feet). The proper trapping of kitchen sinks should never be neglected, on account of their close proximity to the drain. Many fatal cases of sickness have been caused by a neglect of this precaution. The common bell trap, ordinarily used for sinks, is worse than useless, since it cannot be kept clean, and will collect solid matter in the depression with which it is provided. If it is furnished with a strainer, as it usually is, and situated just below the sink, the force of water which passes through it is not sufficient to keep it clean; it soon gets stopped up, and is consequently removed, (if not screwed down), which leaves a direct communication between the drain and the apartment in which the sink is located. The best protection is found in the ordinary S trap, situated below the sink at about the level of the floor, which may be provided with an aperture closed by a rubber stopper for purposes of cleaning. A bell trap at the opening of the discharge pipe, provided with a strainer with large holes, and screwed to the sink, serves as an additional safeguard, and is to be recommended.

Whenever a connection is made between sinks, washstands, bath tubs, etc., and the soil pipes, their discharge pipes must enter below the water level,

otherwise, opening, as they often do, too near the surface of the water in the trap, no effectual protection is afforded against the transmission of gas through them.

VENTILATION OF HOUSE DRAINS.

It is a very common belief that because a drain is trapped, no sewer gas can force its way into the house. But however well a trap may be constructed, its efficiency is much impaired, when used alone, by the comparative ease with which it can be forced by this gas, as well as by its liability to become untrapped. As a proof of the facility with which water will transmit gases, it is only necessary to suspend a piece of any bibulous paper, such as litmus paper, saturated with a solution of sulphate of lead over the opening of any unventilated pipe leading to a drain (perhaps better on the under side of a water-closet lid, which is kept closed) and notice how rapidly the paper will become blackened by the action of the gas, especially if a strong North wind is blowing at the time. Dr. Fergus of Glasgow found that ammonia would pass through the water of a trap, (which he had made from glass, in a manner similar to a house trap, for the purpose of the experiment,) and bleach litmus paper in fifteen minutes, and that sulphurous acid, sulphuretted hydrogen, carbonic acid and chlorine would produce their chemical effects in from one to four hours.

These traps are also very liable to become untrapped from acting as true siphons, by running full, in which case a vacuum is formed below them, by the induced current of air, which will draw out all the water, thus leaving them unsealed.* Another reason for their inefficiency is found in the frequency, with which foreign substances, such as pieces or even shreds of cotton, wool, or paper which is not easily softened, are thrown into the pipes, and being delayed in the trap, with one end hanging out, act as siphons to drain out the water. They are likewise liable to be unsealed by the evaporation of the water in them, particularly where it is not renewed by frequent use.

Even without these contingencies, there are certain forces continually at work in sewers and drains, which will force an unventilated trap with the greatest ease. Thus the compression, to which the gas is subjected in sewers, (which would be increased by an amount, equivalent to a column of water

*This can be partially prevented by making the trap of a larger bore than the pipe into which it is placed.

thirty-four feet high, if the sewer, which had been previously running half full, is made to run three-quarters full) for reasons already explained, no trap in the world, if made perfectly air-tight, could withstand. Even if the trap had a bend of two feet, it would only resist a pressure of about *one* pound to the square inch; whereas if the sewer become half filled with water, a pressure of *fifteen pounds* to the square inch would be produced, with the certain effect of forcing the trap. A striking illustration of this principle was given to me a short time since by a prominent gentleman of this city. After a heavy rain he heard a great noise and gurgling in the bowl of his washstand, which he knew a few moments before was empty, but which upon inspection he found contained water in a violent state of agitation, as though produced by a gas. Without doubt, the sudden filling of the sewers by the rain had caused such a compression and expansion of their air that it was forced upwards, carrying with it the water of the trap. If this state of things had continued for a few days, disease might have been produced in his family, as it was in that of Dr. Carpenter, to which reference has already been made as occurring under somewhat similar circumstances.

The same pressure and expansion are also produced by an elevation of the temperature in the sewers and drains, caused by the admission of hot water, steam, etc., which, as has already been demonstrated, will be increased by an elevation of 100°, by an amount equal to 6.7 feet head of water. How easily an increase of temperature will force a trap, may be demonstrated by filling a flask with air, and introducing into it, through a tight stopper, a bent glass tube filled with water, after the manner of a water trap. The elevation of temperature, caused by simply placing the hand around the flask, will be sufficient to force the air and water out of the tube.

On the other hand, when the sewer or drain is again cooled by a reduction of temperature, or when the volume of water in it has been diminished, a partial vacuum is caused, which must be filled by the entrance of atmospheric air, with the certain effect of forcing the trap in the opposite direction, and in consequence leaving it wholly unsealed.

The escape of sewer air into houses, protected only by traps, is favored by the pressure upon the upper surface of the traps being greatly relieved by the superior temperature of the air of the house, and by the draught caused by chimneys, which tend to draw the atmospheric air to the warmest portion,

and in the direction of the draught. The traps, thus being partially relieved from counter pressure, are easily forced by the pressure of gas from below.

As this ebb and flow, this increase and decrease of temperature in sewers and drains—which alternately leaves the sides of the sewers wet and dry, (thus producing a much larger amount of gas)—is going on all day, and every day, and as by these agencies traps will be forced, without some other provision is made for the escape of the gases, it becomes absolutely necessary that free vents should be furnished, through which these gases would naturally pass, rather than through the more difficult obstacle furnished by the water trap; and through which, rather than through the openings inside the house, fresh air may be drawn into the sewers and drains without forcing the trap.

No matter how well ventilated the public sewers are, it does not, by any means, relieve householders from the necessity of ventilating their own house drains; for the reason that these drains are subject to the same forces, which are at work in the main sewer to produce an expansion or condensation of the gases, but much more powerfully and intermittently.. Then again, for the same reason which prevents the ventilation of main sewers by that of the house drains; that is, by the closing of the outlets of the latter by an increase of water in the former, each house drain must be provided with its own separate system of ventilation. Moreover, the house drain is very liable to become obstructed by grease, or other solid substances, which may have been thrown into it; and hence the gas, which will be compressed by every drop of water thrown into the drain, and which cannot escape into the public sewer on account of this obstruction, must be given a vent of its own, in order that it shall not escape into the house by the various openings which are to be found there. Finally, whenever a large volume of water is thrown into the lower portion of a house drain, a vacuum is produced, which sucks out the water from every trap above.

For these cogent reasons, the ventilation of house drains becomes a matter of necessity, in order to prevent the passage of sewer air into the house. This is most readily accomplished by shutting off, as far as possible, all opportunity for sewer air to pass from the public sewer into the house, by running up a ventilating pipe above the eaves, (which, for reasons already given, should not be the water spout) from the highest part of the trap outside the house, at the junction of the inside and outside house drains. With such a pipe, no matter

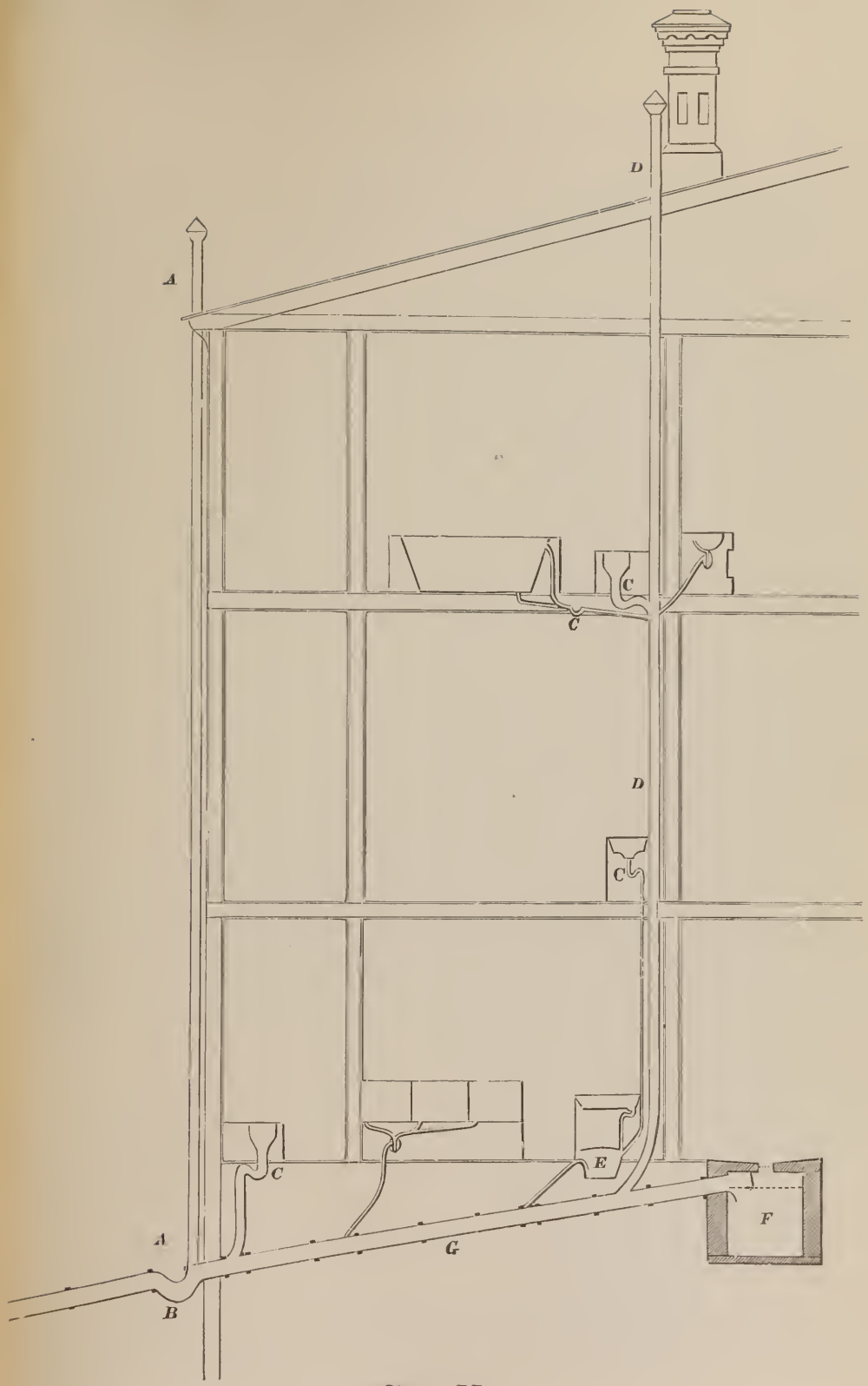

Plate II.

HOUSE DRAINAGE.

A, Ventilating Pipe; ***B,*** Pipe Trap; ***C,*** S. Traps; ***D,*** Soil Pipe; ***E,*** Grease Trap; ***F,*** Catch Basin; ***G,*** Drain.

how much the air might be compressed in the sewer, it would find a ready escape into the open air, without entering the house to exert an injurious pressure upon the various traps, even though the pipe trap outside of the house may have been forced by it.

But owing to the danger, which always exists, of the traps inside the house being siphoned out by the vacuum formed, whenever a large amount of water is suddenly poured into the lower portion of the house drain, and owing to the generation of gases in that portion of the house drain which lies between the outside trap and the soil pipe, it becomes necessary to carry up the soil pipe also directly through the roof, so that by it an escape may be provided for the gases, confined in that portion of the drain which has just been mentioned; and also that atmospheric air may be carried down by it to supply the vacuum, instead of being taken in through the water closets, etc. This pipe furnishes an additional communication with the atmosphere, and both together, with the drain, form the two legs of a siphon, through which there is a free circulation of air down the colder leg and up the warmer one, with no possible chance for the sewer gas to escape into the house. So important is this ventilation of the soil pipe, that if we are restricted to only one of the two methods which have just been described, it is far better to trust for ventilation to the soil pipe carried up above the roof; since by its use not only is the sewer gas prevented from forcing the traps inside the house, but also all possibility of their being siphoned out is obviated.* A double protection is, however afforded by a combination of the two methods. If an additional contrivance should be necessary to procure perfect ventilation, an automatic ventilator such as Capt. Liernur's modification of St. Martin's, may be placed on the top of the ventilating pipe.

Care should be taken that the points of exit of these ventilating pipes are not near a window, ventilator, or the top of a chimney, since at certain times currents of air might draw the sewer gas through them from the ends of the vents into our dwellings.

Our present ordinance in reference to this subject is an excellent one; but I believe that the efficiency of its object will be greatly increased, if it should be amended so as to provide for ventilation of the drain by means of the soil

* The practice of introducing this pipe into the chimney is very objectionable, since, unless the chimney is kept hot, instead of there being an upward draft, there would probably, in many cases, be a downward one, thus forcing the gas down through the fire places.

pipe, as is advocated by all writers upon the subject, and by all commissions which have lately been appointed to investigate the sewerage system. The following is the rule adopted by the Board of Aldermen of Providence, R. I., May 12th, 1873:—

"All persons are required to place an effectual trap in the line of drain just before it leaves the premises, and to make an open connection with a down-spout back of the trap;* also to make an open connection with the highest part of the soil pipe within the premises, through a large pipe or flue, to a point above the roof of the building."

Excellent as the design of all these ordinances is, they are, in this city at least, practically inoperative, for the reason that the Board of Health has heretofore been unable to gain information of the intention of householders to construct house drains, and consequently has been unable to make the needed inspection. To remedy this evil, I would respectfully suggest, that an ordinance be passed, compelling the proper person, before any such drain is laid, or connection made with the plumbing inside the house, to procure a permit from the Board of Health, (as well as from the Board of Improvements), which permit shall specify the kind of trap to be used, and the manner in which the drain shall be ventilated.

Objection may be raised to such an ordinance by some, upon the ground that a man's house is his castle, and therefore the enforcement of such a rule would be unjustifiable. It is very true that a man's house is his castle, but it is at times a castle from which disease sallies out to devastate, it may be, a large part of the community. Over and over again it has happened, that a defect in the drainage of one house has caused sickness in another, or that a contagious disease, which has broken out in one family from its unhealthy surroundings, has spread afterwards to many others. Consequently, if an individual cannot be made to care for his own health or life, he should be obliged, by the proper sanitary rules, to guard others from the effects of his carelessness. We make it obligatory that no nuisance shall be maintained upon a man's premises, and why can we not, for the same reason, prevent his harboring what may be just as bad a nuisance inside his house?

* In reference to the connection by a "down-spout," it may be said that, where there are two ventilators, the outside one may be the spout, though, even in this case, it is better to have an entirely separate connection.

In this connection, I desire to call the attention of your Honorable Body to the glaring defects which exist in the drainage, not only of most of the private residences and business blocks in the city, but also of many of the buildings immediately under the control of the municipal government. There seems to be a singular lack of appreciation of the advantages possessed by sewerage, as shown by the following small list of drain connections, which have been made with some of the sewers already built. I would therefore respectfully suggest to each individual householder the desirability of connecting his house with the main sewer, wherever it is possible to do so.

CONNECTIONS MADE TO JANUARY 1ST, 1877.

Bank Street	26	Michigan Street	32
Superior Street	82	Champlain Street	30
Ontario Street	40	Frankfort Street	20
Lake Street	75	Sterling Avenue	45
St. Clair Street	284	Scovill Avenue	41
Prospect Street*	169	Franklin Street	43
Euclid Avenue†	110	Garden Street	71
Woodland Avenue	159	Fulton Street	63
Sibley Street	49		

The total number of sewers connections upon the above streets is 1,339.

Even in those instances, where such connections have been made, there has been but little attempt to protect the houses from the entrance of sewer air. Many of the prominent business blocks have been inspected, and very few found where defects in the drainage have not been made manifest by disagreeable odors.‡

Although the drainage system of the City Hall is excellent in almost all its features, (the soil pipes having been carried up above the roof), yet I am confident that an additional protection would be afforded against the admission of sewer gas, if the provisions of the ordinance were carried out, and a venti-

* There are 344 houses upon this street, between Ontario Street and Willson Avenue.

† Upon Euclid Avenue there are 214 houses, between the Square and Willson Avenue.

‡ A prominent physician, occupying an office in one of the largest and finest blocks in the city, has recently informed me that upon one occasion he was nauseated by the sewer gas, which was forced up through his wash-basin.

lating pipe erected on the outside of the building, at the junction of the inside and outside house drains.

Many of our school houses—the very buildings which, of all others, should be in the very best sanitary condition—are exceedingly faulty in this respect. In some, the privies, which are imperfectly ventilated and flushed, are located in the cellar, thus giving an opportunity for the sewer gas to ascend from imperfectly trapped and ventilated drains through the floors into the school rooms. These evils, wherever they exist, should be immediately remedied by properly trapping and ventilating the drains, and by providing better and safer privy accommodation for the scholars, since the inhalation of the sewer gas, which under the circumstances is unavoidable, is highly injurious to health. An instance of this occurred in New Bedford, Mass., where, from one of the schools, eleven scholars died of diphtheria, which they were supposed to have contracted from sewer gas, which was drawn through an open window into the school room from a privy in close proximity to the building.

Particular attention and care should also be given to those school houses which have their wells and privies in such relation, that there is danger of the filth leaching from one into the other.

I also beg leave to call your attention, in this connection, to the grossly unsanitary condition of the Central Police Station, which in my estimation is totally unfit, from the radical defects which exist in its ventilation and drainage, for further occupation. These defects, I believe, can only be remedied by either a thorough alteration of the present structure, or by the erection of an entirely new edifice.

WATER-CLOSETS.

Of all means yet devised for the removal of human excreta, the water closet is by far the best, provided it is properly constructed, is carefully watched, and its mechanism thoroughly understood, not only by the artisan, but by the householder himself. Otherwise it becomes a nuisance worse than that greatest of all abominations, the accumulative privy; since by its agency sewer gas, instead of being discharged into and diluted by the atmospheric air, is conveyed unmixed directly into our dwellings. Mr. Latham says of them:*

* Sanitary Engineering, page 328.

"Most of the complaints, which have been raised against the water-carriage system have been directed against the water closet, as being the source of nuisance, when introduced within a house. These complaints have in many instances been well founded, as there cannot be a shadow of doubt as to the nuisance caused by many descriptions of closets; but the remedy is not to abandon the water-carriage system, but to correct the defects in the form of closet, which have given rise to these complaints. A good water-closet is the only appliance fit to be used within a house, for by it all matters are at once conveyed away, and cease to have the power of producing evil so far as our houses are concerned; it is not so with those systems that *conserve* fæcal matters within, or in close proximity to our dwellings, as there is always danger in storing a dangerous article, however we may tend and guard against its evil effects"

There can be no doubt of the advantage of this system, if it is scientifically constructed; but, on the other hand, there is nothing which will so quickly affect the health, or possibly the lives of those who use it, as this modern convenience. The Medical Officer of Glasgow* says that diarrhœa, cholera, diphtheria and dysentery have increased fourfold since the introduction of the water-closet system.

In 1872, the Medical Officer of Edinburgh asserted, in his Report, that whenever water-closets had been introduced in that city, double the number of deaths from typhoid fever and scarlet fever had occurred in one year, and any epidemic occurring in these houses had assumed a very malignant form.

Dr. Cohen of Philadelphia wrote to me some time since that diphtheria had prevailed more extensively in that city, since the introduction of the modern water-closet.

In Holyoke, Massachusetts, two severe cases of diphtheria occurred two years ago in the houses of wealthy citizens, which were attributed by the medical attendants to imperfectly constructed water-closets.

The great trouble with the water-closet system has been, and will continue to be—unless architects, builders and householders will give more attention to the subject—that it has been very imperfectly understood. But little study

* Dr. Fergus.

has been given to this subject, even by those whose business it is to know all about the details of house construction; a water-closet has been looked upon simply as a convenience, as a privy within the house, one which does not have to be cleaned out, and which, when once constructed, can take care of itself. Its construction is left to those who cannot be expected to realize the dangers which may arise from its defects, (even if this subject is at all understood by its owner), and who know nothing whatsoever about the science of the change of temperature, compression and contraction as affecting sewer gas. For all such persons the inconveniences of an out-door privy is a blessing; for dangerous as this always is, yet it is much less prejudicial to health than a defective water-closet.

"In considering the admissibility of water-closets," says Dr. Simon, "it has always to be remembered, that the working of an ordinary water-closet is easily deranged; and that water-closets, when out of order, and especially if in the interior of houses, are apt to become very dangerous nuisances. The ordinary water-closet is, therefore, a thoroughly ineligible form of privy for those who are unlikely to take proper care of it, or who are from poverty unable to give it such occasional repairs as it may require.

Among such classes of population it is of course unfit that any form of in-door privy should ever be sanctioned: but even in the best ordered houses the occasional danger of in-door water-closets must not be disregarded."

The importance of this subject, particularly as the water-closet system is destined to be perpetuated, demands therefore a more thorough knowledge of it. In order that a water-closet should fulfill its object of a health preserver instead of a health destroyer, it must be so made that it will remove its contents effectively and quickly, and without permitting the escape of sewer gas into any part of the house. In order to accomplish this the following conditions must be observed:—

First. It must be entirely removed from any communication, either near or remote, with sleeping or living apartments.

Second. There must be a *constant* water supply of sufficient force to flush it thoroughly, and drawn from the proper source.

Third. The drainage of the house and town must be so arranged, that the additional amount of sewage, which this system necessitates, can be effectively removed.

Fourth. The whole house drainage system, which is the necessary outgrowth of the water-closet, must be under the control and inspection of the the proper authorities.

As to the location of the water-closet, as well as the bath tub and washstand which are frequently associated with it, great carelessness is everywhere manifested. Very little thought ought to convince most persons, that a direct communication between a drain and any apartment in the living portion of a house, particularly if this apartment is a sleeping room, would be dangerous to health, on account of the facility with which the gas from the sewer can be transmitted, when any of the many defects, which have already been pointed out, exist. And yet in the vast majority of houses these last links in the chain, of which the public sewer with all its filth is the first, are found in close proximity to, if not actually in sleeping rooms, to carry the noxious vapors into the system, when it is the least prepared to resist their influence.

The water-closet, or any appurtenance connected with the sewer should be placed as far away as possible from a living room, and never under any circumstances be located in the room itself, or in a closet or dressing room leading from it. "Under no circumstances," says Dr. De Chaumont, "ought there to be a closet opening directly into a bedroom, the merely occasional convenience of such an arrangement being more than counter-balanced by its danger and generally objectionable situation—almost equally objectionable as the arrangement, where the closet opens into the lobby or landing close to the bedrooms or sitting rooms, a plan both unhealthy and in every way offensive."

Wherever placed, strict attention should be given to the ventilation of the room, in which the water-closet is located, by a window over the closet and opening from the top—a precaution which is almost always entirely neglected, the closet being tucked away in a dark, oftentimes damp corner, (the very soil in which disease germs retain their vitality), with no chance for the escape of the sewer gas, which emanates from it, excepting into the house.

FLUSHING WATER-CLOSETS.

It is of primary importance that there should be sufficient water to thoroughly flush the water-closet every time that it is used, so as to rapidly carry off the matters discharged into it; otherwise it will become foul and give rise, as has often happened, to serious disease. That this accident should ever occur in this city is not probable, since we have a supply of water which is inexhaustible, and yet in some of our public buildings, in some of our schools even, there are water-closet arrangemets which only receeive a flushing once a day.

One source of evil arises from the fact that the water supply, although supposed to be constant, is sometimes not so, being shut off either for repairs in the street or more prequently for repairs to the house pipes. Again, whenever water is drawn from a faucet down stairs, the supply to the water-closet above is often cut off, and if under any of these circumstances the closet is used, there will be no water to flush it properly.*

In this connection, I cannot refrain from alluding to the condition of many of the water-closets upon the railroad cars. The water supply to these closets, if there is any at all, is so insufficient that they reek with filth, sending off a volume of offensive vapors, which, especially in the winter season, when the car windows and ventilators are closed, and the car heated to a degree only short of suffocation, are drawn directly into the space occupied by the passengers. Under these circumstances it is much better that these contrivances should be taken away entirely, rather than, without proper and sufficient flushing appliances, they should be left to render the car offensive.

Another great defect in the system of water supply to water-closets, and one almost universally found, is the dependence for flushing upon a branch from the main water pipe in the house, from which drinking water is derived. This is objectionable, for the reason, that, when the water supply for any reason is cut off, or when water is drawn from the lower portion of the house, the water pipe above is emptied, and foul air, which is present in the interior of the closet or above the trap, is sucked into the main pipe through the water-closet branch to fill the vacuum, thus contaminating the drinking water. That dangers from this source are by no means hypothetical, has been

*Many water-closets are constructed to receive a constant trickling of water, which is an objectionable practice, since it is wasteful and does not perform a proper flushing.

too well established by well-authenticated facts. One, which is often quoted, is the instance of a severe epidemic of typhoid fever, which broke out a few years ago in Cauis College, Cambridge, (England), where the most thorough, and, as was thought, the most perfect system of water supply and drainage had been introduced. Upon investigation, it was found that the drinking water had been polluted in precisely the same manner as has just been mentioned, viz:—by emanations from the water-closet containing the contagion of typhoid fever. The whole difficulty was caused by a valve, which guarded the outlet of the branch pipe, having been placed horizontally instead of vertically to be influenced by gravity, and thus permitting the escape of foul vapors into the main water supply. This case is interesting, as showing from what trifling causes sometimes the most serious results will follow, and how careful workmen should be to perform their work in a proper manner.*

To remedy both these evils, viz:—the danger of having at times no water to flush the closet, and that arising from the vapor or fluid filth being sucked into the main water supply, service boxes or tanks may be used, which, being full, will always (or at least for the time, during which otherwise the supply would be deficient) furnish enough water for the necessary purpose. So important is this provision considered in England, that a regulation has been made by the Water Companies of London, which compels all water-closets and urinals supplied with water by them, to be provided with a cistern or service box, from which the necessary flushing water shall be taken.

In many of the houses in this city, illy heated as they are, such a tank would be in danger of freezing, unless it was carefully protected. When however such an appliance is practicable, it should be employed, as it is the only protection which can be afforded against the dangers which have been mentioned. Old fashioned as the service tank is considered by many, yet together with the bowl and pitcher it is coming into vogue again.

The most serious source of evil, however, arises from the construction of the water-closet itself, which is most always faulty, particularly that form which is known as the "pan" closet, (the one in most general use), and which has been condemned in the strongest language by all writers upon sanitary subjects.

* Further details of such cases may be found in the Appendix to the Report of the Medical Officer to the Privy Council, New Series, No. 2, 1874.

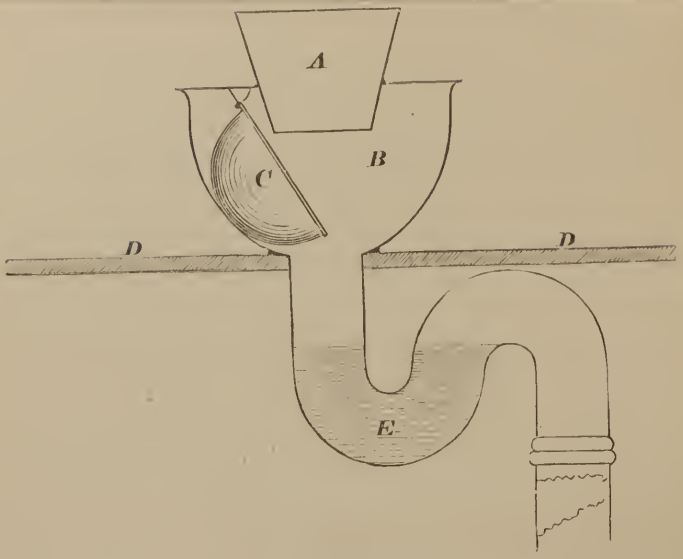

FIG. 5.
PAN CLOSET.

A, Crockery Bowl. *B*, Iron Receiver. *C*, Copper Pan. *D*, Floor. *E*, S or Siphon Trap.

The great and irremediable objection to the pan closet lies in the fact, that the iron receiver becomes fouled by deposit every time that the pan is tilted, and cannot possibly be cleaned: while from the decomposed matter, which adheres to its sides, gases are generated, which fill the receiver and are forced out into the room by the water discharged into it,—a realization of which is obtained from the whiff of foul air, which at this time greets the nostrils. To add to the evils, the trap below the receiver will usually become foul, and give off gases to increase the volume of those already collected in the receiver; the various apertures outside the bowl furnish a direct communication between the interior of the wooden casing and the soil pipe, and the gearing, with which the closet is provided, is invariably loose and easily disarranged.

The various contrivances, which from time to time have been suggested as remedies for these defects, are but partially successful, and are at many times wholly inoperative. As they add largely to the expense of the closet, making its cost fully equal to, if not greater than the more efficient varieties, it is far better to adopt at once that form, which will fulfill all the objects of a good system.

A better form of water-closet than the one just described, and one which is free from many of the objections, is the hopper closet, of which the best variety consists of a bowl of crockery and trap made in one piece. The advantages of

the hopper closet consist in there being no metal receiver to become fouled and to give off gases: its defects are found in the direct exposure of the contents of the trap to the air, which, however, can be remedied in a measure by a proper ventilation of the soil pipe and the space between the seat and bowl, and by thorough flushing, which in this variety is of primary importance. If this constant and forcible supply of water cannot be obtained, the hopper closet is exceedingly objectionable.

By far the best variety of water-closet, however, and the one recommended by all sanitarians, is that known as the Jennings closet, since, as it is now constructed, it fulfills all the requirements of a perfect system.

The construction of the Jennings closet is shown in the following diagrams.

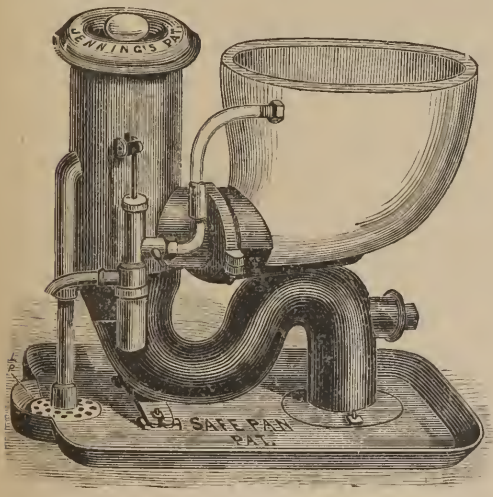

FIG. 6.

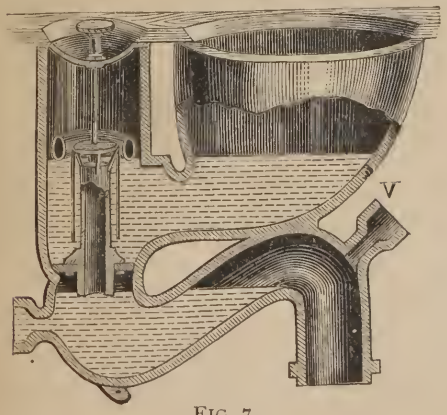

FIG. 7.
V. Vent.

In Fig. 6 is represented the latest form of the Jennings closet, which is provided with Myers' solid iron bulb plunger, kept firmly in place by means of a rubber flange. Its weight insures it against displacement, and its solidity against the transmission of gases. The outflow is provided for by means of a pipe, which discharges into the mouth of the safe waste, where there is a shallow bell trap. This trap is insufficient to render any important service, and if the safe waste is carried into the soil pipe branch, the practical advantage of the solid plunger is lost. If however the safe waste is carried separately to some point where it can discharge, and has no direct connection with the sewer, the solid plunger seals the closet effectually. Such an independent overflow and safe waste is rendered necessary

by the construction of the closet, and if not provided, the security afforded by the solid plunger cannot be considered complete.

As originally constructed, with a hollow plunger to provide for the overflow, the Jennings closet was defective, since the plunger did not seal the waste opening, except to the extent of keeping the water in the basin up to a proper level. This left the closet dependent upon one seal, and that a water one, and the gases passing through the water by transmission, or forced through it by compression, found a comparatively easy escape through the hollow plug.

To obviate these defects, the Blunt siphon overflow trap plug has been devised. It consists, as shown in the sectional diagram, Fig. 7—which also shows the interior of the Jennings closet—of a movable hollow stand pipe or plug, covered by an inverted cap, the opening to which is constantly submerged in water, when the plug is at rest. It is a great improvement over the hollow plug, which is ordinarily used in the Jennings closet, and can be substituted for it, where the old style is in use. It is not, however, so completely effectual as the solid plug already described.

The great advantage of this closet is, that it forms a trap itself, whereby two seals are provided, thus obviating all necessity for a separate trap below; and also that the entire water supply for each flushing is contained directly under the seat. Into this large reservoir of water faecal matters are immediately dropped, and being immersed are partially disinfected; and the whole is carried off in a rapid flow, every time the handle is pulled. The water supply for this closet may be, with greater security than in the other varieties, taken from the main water pipe, without the intervention of a service tank, since the branch to it is supplied with flap valves, which swing outwards with the current of water, and afterwards fall into their places by their own weight, thereby preventing the escape of gas or filth into the main pipe.

In the Jennings closet a vent is very necessary to admit air, whenever the closet is worked, in order to fill the vacuum produced by the sudden rush of water down the soil pipe: otherwise the trap would be very liable to be siphoned out, and the closet, which depends for its safety entirely upon the water seal, become the very worst variety of all. This vent, however, does not obviate the necessity for the proper ventilation of the soil pipe.

When several water-closets of any variety are situated one above the other, upon different floors of the same building, as in hotels, public edifices, etc., it

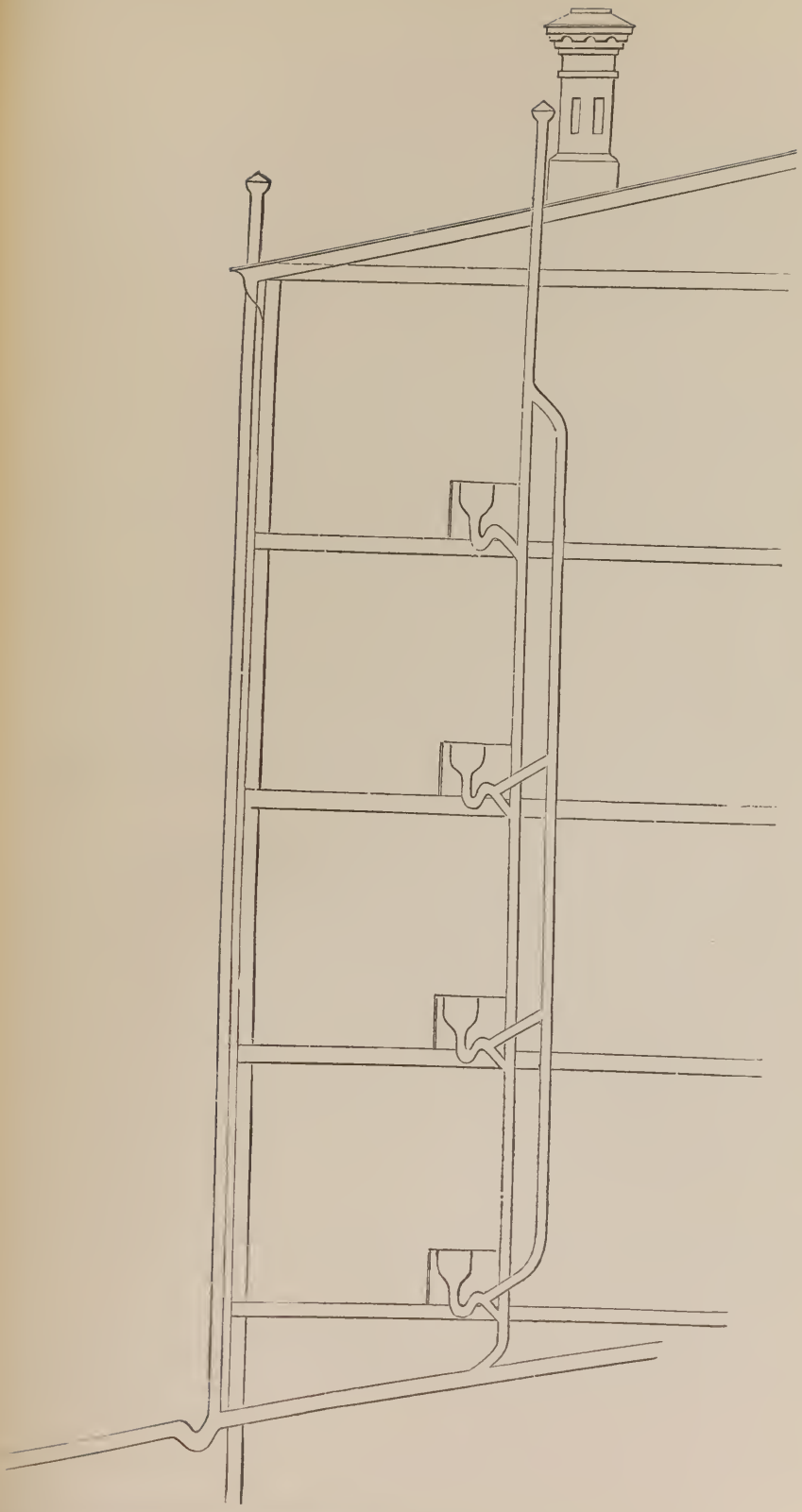

Plate III.

is desirable to provide each one, with the exception of the upper one, with a separate vent, as shown in Plate III. Without this vent, whenever water is discharged down the upper closet, there would be danger of its siphoning out the water from all the traps below, on account of the induced downward current of air which is caused by the sudden rush of water.

EARTH CLOSETS.

As dangerous to health as are all badly constructed and illy managed water-closets, yet more injurious still, from its pollution of the air and drinking water, is the privy vault.* "Of all the filth influences which prevail against human life," says Dr. Simon, "privies of the accumulative sort operate undoubtedly to far the largest extent." So prevalent is this opinion among scientific men and local authorities, that their attention has been directed to remedying the evils of this system by supplying some other means for the removal of human excrement, less injurious to health. The system, which at the present day has received the greatest amount of consideration, both in the United States and in Europe, is the dry-earth plan, which has for its fundamental principle the well-known antiseptic and purifying powers of dry earth.

This question has a peculiar interest for us, since, even in the drained districts of the city, the privy vault is extensively used, and oftentimes in close proximity to the well from which drinking water is derived. Besides, in certain portions of the city it is impossible to dig a vault deeper than five or six feet, without striking water—one of the worst things to introduce into it, since the more fluid the filth is, the more easily does it leach through the soil, and the more readily do the contents of the vault decompose. No ordinary brick vault even will keep this water out; and as a consequence, particularly if the vault is dug deeper than five or six feet, it will overflow, unless in the dryest weather.

The object of this system is to supply, by the necessary apparatus, dry earth to cover the excrement, in order that it may become thoroughly disinfected,

* The danger arising from these privies was conclusively shown by the eleven deaths, which occurred from diphtheria among the pupils of a New Bedford school, of which mention has already been made.

and consequently not pollute the soil or atmosphere;* and to provide, secondarily, a manure which, by the agency of this system, is formed.

There can be no doubt that the dry earth, or its equivalent the ash closet, is the best plan which has as yet been devised for such congregations of people as are found in barracks, hospitals, prisons, etc., not supplied with perfect water-closets; for operatives in manufacturing districts, where close and constant inspection can be made by those who are connected with the institutions or factories, or for private individuals, who have no drainage facilities, and who can make the proper disposition of the manure which is made. But that it can be universally introduced into communities, whose members have to be narrowly watched to be kept up to the proper standard of sanitary excellence, (the very class whose privies become nuisances), has been proven by experience to be a matter of grave doubt. As the receptacles are small, they need frequent attention; earth must be thrown in every time they are used; the contents must be removed frequently and dried, and the manure taken away, when it can no longer be used for the disinfection of the excreta. This would necessitate more sanitary inspection than could possibly be given to it. Even if any one could be found to take the contract for the removal of the manure, as is now done with the night-soil from privies, the difficulty of procuring earth, which must be a clayey loam *thoroughly dry*, easily broken up, and containing no vegetable matters, would always be an objection to the extensive use of this system in all cities. To procure the requisite amount of earth to supply this city of 162,000 inhabitants, allowing a cubic foot of earth to every ten persons, (equivalent to nine and three-quarters pounds per day, the amount necessary to deodorize the excreta of an adult), it would take 16,200 cubic yards of earth to supply the daily wants of this city, or, at the depth of soil which could be used, nearly nine hundred acres annually!

Another objection to this plan, even under the most favorable circumstances, is that a supply of earth must be stored away to provide literally for a rainy or snowy day, when it would be difficult to get the earth as dry as is necessary. Moreover, when the means have been provided for the removal of human excrement, a small portion only of the refuse of an ordinary household has been provided for; since it has been estimated that for every pound of excreta removed by the earth system, there are one hundred and ninety pounds of

* So thoroughly does the earth purify the excreta, that, even though mixed together, it can be used five or six times over (if dried), without any offensiveness whatsoever.

Rochdale Corporation
Pattern Pail closet.

A. excrement pail.
B. ash tub.
C. seat cover (raised)
D iron collar below seat, reaching slightly into pail when cover is down.
F. hinged upright of seat
G. door admitting from outside to excrement pail.

Plate IV.

liquid refuse, which must be disposed of in some other way. Drains therefore become a matter of necessity, and if these can be built, it is far better to remove *all* refuse matter, whether solid or liquid, by them, rather than to allow any accumulation of it upon the premises.

The method, advocated by J. N. Radcliffe of England for out-door privies, is free from many of the objections which have been advanced against the dry earth system. This is the ash closet, the simplest form of which is the Hull pattern, which is provided with a receptacle, having a floor of an impervious material.* Into this receptacle, immediately or shortly after its use, ashes and the dry refuse of the house are thrown, making with the excrement a dry, inoffensive mass, which is removed once a week with a spade "by removing a movable board in front."

Another excellent form, to which I would respectfully call your attention, is the Rochdale pail system or its modification as used in the United States, a diagram of which, taken from the Massachusetts Health Report for 1875, is shown in Plate IV.

The Rochdale closet is provided with half of a kerosene barrel, holding one hundred pounds, which is removed weekly, or semi-weekly if necessary, and an empty disinfected tub supplied in its place. As in the Hull pattern, disinfection is accomplished in this form by means of ashes and other dry refuse of the house.

So great are the evils which are attached to our present privy system, (since, built as judiciously and as carefully as possible, the vaults, unless disinfected every day, may become dangerous to health, particularly when a well is situated upon the same premises), that, whenever it is practicable, some form of dry earth or ash system should be employed. Particularly is this system to be advocated in those sections of the city, where it is impossible to dig a vault without meeting water which makes the privy the worst of all possible nuisances. A similar plan has been adopted in Washington, in which city a shallow box costing $1,50, coated on the inside with asphalt, at an additional expense of fifty cents, is quite extensively used, and has proved very satisfactory.

If privies however continue in use, as undoubtedly they will in every city, they should be built so tight that the danger from leakage of their contents would be reduced to a minimum. Consequently I would recommend that the

* Asphalt is excellent.

present sanitary ordinance, which prescribes that the privy vaults shall be made water-tight or *otherwise* at the discretion of the Board of Health, be amended, so as to make it obligatory upon every one, who intends to construct such a vault, to build it as absolutely water-tight as it is possible.

CESSPOOLS.

Of all methods yet devised for the disposal of filth, that of the cesspool is the worst, for in them organic matters accumulate, and are brought into the presence of the three factors—heat, darkness and moisture—which cause decomposition. They thus become centres of filth of the worst kind, which send up poisonous gases to pollute the air we breathe, or if under the house, as often occurs, directly through the floors into our very dwellings. Even if placed at a distance from the house, the gas will certainly be drawn in through the open windows by the heat of the house, or by the cold-air box of the furnace, (if one is used), to be sent up through the registers into the living rooms.*

Instances of disease occurring from cesspool filth, leaching through the soil and contaminating drinking water, have already been given; equally striking examples may be found in the literature of the subject of disease arising from the sewer gas given off by them.

The extensive system of cesspools existing in Paris, which were obliged by an ordinance, passed in 1820, to be built hermetically sealed, is an example of the offensiveness of this form of filth disposal. Of these cesspools, Mr. Rawlinson, a distinguished engineer of England, wrote in 1865 as follows:— "Nothing could be more beautiful than the order and cleanliness of its (Paris) paved streets, but the stench even in the best houses was almost insupportable. The possibility of hermetically-sealed cesspools was therefore a fallacy."

Even if cesspools contain nothing but the liquid refuse of the house, they are almost as bad as when human excreta are discharged into them, since gases of decomposition are as readily given off by house slops as by the excreta. Therefore, whatever organic matter, whether that contained in fluid or solid refuse, may be thrown into them, cesspools are objectionable in every way, and should be discontinued as rapidly as possible.

* This cold-air box has been blackened through its entire length by the gas from cesspools.

The importance of this whole subject of sewerage cannot be over-estimated, and should not be overlooked; no matter from what standpoint we look upon it, whether from a consideration of the evils arising from want of sewerage, or from imperfections in a system already existing, it demands the closet attention. The relation between filth, which improper sewerage creates, and disease has been abundantly proven, particularly in cities, where large masses of people are crowded together, and where, if an epidemic of any disease breaks out, it tends to run a more rapid and fatal course. This is especially true in the case of children, whose delicate organizations subject them to a more ready inception of the poisons of disease, and to a more rapid deterioration of health, when exposed to unhealthy surroundings. I am very confident that, apart from the many deaths occurring among children from pronounced disease, there are many cases of impaired health, characterized by debility, headache, impaired digestition, and other symptoms comprising that expressive condition, "out of sorts," which cannot be readily explained upon any other supposition than the existence of filth. The extent to which filth exists is beyond comprehension. "To a really immense extent," says Dr. Simon, "to an extent indeed which persons unpractised in sanitary inspection could hardly find themselves able to imagine, dangers of these two sorts (pollution of the air by gases of decomposition, and contamination of wells and springs by liquid filth,) are prevailing through the length and breadth of this country (England), not only in their slighter degrees, but in degrees which are grossly scandalous, and very often, I repeat, truly bestial."

I do not mean to assert, by any manner of means, that we are altogether in an unsanitary condition, for our low rate of mortality would refute any such assertion; but what I desire to impress upon your consideration is, that with our healthy location, with our scattered population of 162,000, occupying five more square miles than in the City of New York, with nearly a million of inhabitants, the death rate should be materially less than it is now. That our mortality can be decreased I have not the slightest doubt, if individuals would but recognize what is meant by filth, and the effects produced by it; and not delude themselves with the belief that, because their surroundings *seem* healthy, that, because their houses are provided with every modern luxury, no filth exists about them. This assumption of cleanliness is often made by individuals, either through ignorance of the sources of filth, ignorant that the privy vault

or slop waters thrown upon the ground will just as readily give off sewer gases as the organic matters within the sewers, or from the natural reluctance, which every one feels, to acknowledge even to himself that his house or premises are in an unsanitary condition. Possibly, however, he may have hastily assumed that no cause existed for disease in his house, because his search for this may not have been immediately rewarded by discovering it. In 1868, five members of a family were successively attacked with typhoid fever in Watertown, Mass. A foul smell had been perceived soon after the first case had occurred, and the drain was taken up and examined, *but nothing wrong was discovered.* Some weeks later, *a more careful search* being made, it was found that an opening existed between the drain and an air box, which conveyed air from without to a chamber behind the kitchen range, and thence to the bath-room and other parts of the house. *A third search* being made still later in the season, another opening was discovered beneath the wash-room floor. The workman who took up the floor was so overpowered by the effluvia, that he had to be assisted to the open air.*

In this case, if the owner of the house had been contented with the first search, as many would have been, he would have concluded that no cause whatsoever existed for the outbreak of fever, and consequently endangered the health of his household by the assumption.

The fault, if fault there is, sometimes rests with the medical attendant, who hastily makes up his mind that no unsanitary condition exists, simply because it is not readily made manifest to his sight, taste or smell. But, as has been already pointed out, because filth is not suspected, it does not prove that it does not exist; it may lurk in the drinking water, which is not condemned, because it has neither an offensive odor nor an unpleasant taste, or because the microscope has failed to detect in it the germs of disease; or it may be present in the gases of decomposition, which are not recognized, because they may not give out a sickening smell. The source of filth may not be evident to the sight; it may not be the pig-sty, the manure or compost heap, the privy, the cesspool, or the slop water, from which the wind blows the emanations into the house; it may not be the drinking water, so fouled by filth that it is nauseating to the taste—but it may be the pile of decaying potatoes, which, buried under the kindling-wood, has not been suspected, but which none the less surely caused an

* Massachusetts Medical and Surgical Journal, Feb. 4, 1869.

outbreak of typhoid fever in the house of one of our prominent physicians: it may be the sudden filling of the sewer with rain water, which has compressed the sewer gas through unguarded inlets into the sleeping room; it may be the leaking soil pipe in the wall, such as caused the erysipelas in Middlesex Hospital; it may be the cesspool gas, which has been conveyed by the cold air box through the furnace to our living rooms; it may be the minute defect in a water-closet valve being placed horizontally instead of vertically, such as caused the outbreak of typhoid fever in Caius College; it may be in the ice, such as caused the intestinal disorders at Rye Beach; it may be in the milk, such as has produced so many outbreaks of typhoid fever in England; or it may be that the cause exists in houses built on hills, in which the most skillful engineers and architects have exhausted, as they believed, the resources of modern science, from the sewer gas which has ascended by its lightness through drains having a rapid fall.*

Moreover, filth does not always operate where it stands. It may not be upon the premises where disease has broken out; it may exist upon the premises of our neighbors, in a broken soil pipe, such as was supposed to have caused the diphtheria to attack a prominent physician of New York; it may be that from a *neighbor's* privy the filth has leached into *our* well; it may be that from *his* cesspool, *his* slop water or from *his* defective drain sewer gas has escaped into *our* house; or it may be that the ventilation of the main sewer by rain water spouts, has produced disease, as it did so markedly in Croydon. But filth may not advance upon us from the *next* lot; it may invade our houses from long distances off, to cause disease, as shown by the following example:—

A large pile of decaying fish upon the farm of Daniel Webster, in Marshfield, caused an outbreak of typhoid fever three miles away, the prevailing wind blowing steadily from the direction of the deposit. Puerperal fever has been observed to break out in La Maternite Hospital (Paris), whenever the wind blew from the direction of a slaughter house some distance off. Thirty cases of typhoid fever occurred in a hospital in Dublin, on account of its drinking water having been polluted by typhoidal excreta, which had been discharged into the stream from some barracks twenty-five miles higher up.†

* This was the cause of the typhoid fever in Cassels and the cholera in Oxford, attacking most severely the houses in the upper part of the town.

† This case is related by Dr. Mapother, Health Officer for Dublin.

Country districts form no exception to the rule. Because an epidemic of disease breaks out in the country, it is unwarrantable to assume that filth has nothing to do with its causation, simply because it has occurred in the country. The sanitary condition of rural districts is notoriously bad, and in them epidemics often rage with great intensity and fatality. But it is because they are very frequently cursed by an entire lack of drainage, with slop waters, privies and cesspools polluting the ground, well water and springs, as well as the atmosphere; because the members of the household frequently occupy, as a living room, one upon the ground floor, in close proximity to the source of the gases which float in at the open window, or because the soil is damp, to produce, as has been mentioned, malaria, consumption and diphtheria.

On the other hand the physician, actuated by a proper sense of his responsibility to assign a cause for disease, in order that it may be eradicated, may suspect a drain, well or cesspool, but has not the time to give the patient research, which is necessary to discover the half hidden, wholly buried defect, which has produced the sickness; has not the opportunity to dig into the ground, to see whether the soil between the privy or cesspool and the well may not have been blackened by the privy filth; has not the opportunity afforded him to tear down a wall to discover a leaking soil pipe, from which sewer gas is escaping, and hence, though not satisfied, reports that no unsanitary cause exists to account for the outbreak of a preventable disease.

A great responsibility, therefore, rests upon those, who hastily assume that no unsanitary condition exists to cause the many diseases, which are now recognized as in a measure preventable—an assumption which too often induces a false sense of security, from which they may be roughly awakened by the presence of death. There has never been a time, when physicians were more thoroughly convinced, that great care should be taken in pronouncing too hastily *against* a cause existing for certain diseases; since the opinion is growing, that filth exists as an originator of sickness much more frequently than is even suspected. I do not mean to affirm, however, that filth must be sought as a cause for *all* outbreaks of certain zymotic diseases; I do not intend to deny that these diseases have broken out in perfectly healthy places, in houses beyond sanitary reproach; but what I do insist upon is, that many diseases seem to have their origin in filth, but are carried by contagion to habitations or districts, in which no filth whatsoever can be found.

VENTILATION.

Intimately connected with the subject of filth and sewer gas is that of ventilation, since, in the presence of defective ventilation, their deleterious influences are most markedly felt.

Irrespective of these conditions, however, imperfect ventilation has a decidedly injurious effect upon the health. Every one can understand that it is unpleasant to enter an illy-ventilated apartment, and that, after a few minutes, headache and lassitude may result from it; but it is not every one who realizes that great debility and impaired digestion, that severe colds, consumption and other diseases of the respiratory organs may be caused, and "the development of glandular enlargement and scrofula in their more severe forms" favored, by confinement in the foul atmosphere of an unventilated room. "Although," says Ruehle, "we cannot reduce the relation between bad air and consumption to figures, yet it is an undeniable fact, that bad air does produce diseases of the respiratory organs, and especially consumption."

Upon these points medical science is thoroughly agreed, and consequently the proper method of ventilation becomes an important study, particularly to those who have a number of children under their care.* It is a well-known fact, that there is scarcely a school-house anywhere in existence, in which any sort of proper ventilation has been provided, in which the air, polluted by emanations from the lungs, skin and clothing of the pupils, coming from all sorts of habitations, is not, after the commencement of school hours, highly offensive to the nostrils, and detrimental to health. This is certainly criminal, and school boards should be held responsible for injury inflicted in this way; since it is a well-known fact, that at an age when a child is developing its lungs and strength, it requires the very best care, not only mentally and morally, but also physically; for habits, whether of mind or body, contracted at this time, are apt to be lasting, and, if injurious to health, often leading to death.

The schools of this city, though unsurpassed in their method of instruction by any other school system in the world, are no better off in the matter of ventilation than those of any other city.

* In the Rotunda Lying-in Hospital in Dublin, previous to its ventilation, one out of every six newly-born children died. After pure air had been furnished by a proper system of ventilation, the mortality was reduced to one in one hundred and four!

This defect is by no means confined to the school-houses. There is not a public building in Cleveland, with the exception perhaps of the new Court House, the Opera House, and the Case Avenue School, in which any *systematic*, scientific attempt has been made to provide pure air, or in which the atmosphere in the mornings, when the windows and doors have been closed over night, is not extremely disagreeable. The same remarks may be made of residences, in which persons sleep in rooms whose air is oftentimes worse than that "which they give to their parlor furniture."

In its most favorable form, this foul atmosphere is bad enough, but it is infinitely worse when it contains an admixture of sewer vapor, no matter how derived, which oftentimes escapes into houses by the various inlets for it which they contain.

The importance therefore of good ventilation cannot be too deeply considered, and the best means for providing it must always receive the attention of sanitary bodies. The idea uppermost in the minds of many persons is, that to secure good ventilation, all that is necessary is to open a window. This is highly objectionable, for though fresh air, and oftentimes too much of it, is admitted in this way, with the frequent result of producing cold, yet no opportunity is given for the exit of the foul air, which is the very object of perfect ventilation. The first result to be obtained by a good ventilating system is not solely to let in fresh air, but to furnish a ready passage outwards for the foul air. To accomplish this, the openings to the ventilator, or one at least, should be placed at the bottom of the room, since the cooled, heavier gases (carbonic acid) descend to the floor, and from this point should be removed, since they do not show much of any tendency to ascend, to pass out of a ventilator at the top.* Just as soon as that portion of the air which is at the bottom of the room is carried off, the warmer portions at the top descend to take the place of that already drawn into the ventilator, and again these gases in their turn are carried off. But as all gases tend to a pretty even

*It was formerly thought that carbonic acid was specifically a poisonous gas, but now chemistry affirms that it only destroys by its obstruction to respiration; in other words, that through its agency the air becomes so adulterated, that it is unfit for respiration. That it is not poisonous, is proved by the fact that workers in soda water establishments are not affected by it. But although it is innoxious, its presence is the most reliable test we have, that the air which contains it is impure, and "as the other and more harmful parts of a vitiated air are known to bear a tolerably constant relation to this product, we come to look upon the chemical determination of its presence, as an accurate guide to our determination of the rest." (*Nichols.*)

diffusion through the air, it is often a good plan, particularly in a large crowded room, to place another ventilator opening at the top of the room ; care being taken that these openings are not placed upon the same side as the opening for the admission of air. The openings for the exit of foul air should be into a circular or square shaft (at least for large buildings such as school houses), heated either by a fire or coil of steam pipe, in order to secure a draught. If, however, the house is heated by a furnace, the heat from the register is generally sufficient to produce enough heat in the shaft to create an efficient draught ; otherwise the shaft must have a separate means of heating. The best method for securing the outward passage of the foul air is an open fire place, in which a fire is kept burning, opening into a large wide jawed chimney, and consequently is to be recommended, whenever it is practicable. Care should be taken, however, that a fire place is not called upon to do too much, since it has been estimated that one of these will only exhaust the air for twelve persons. The very worst method is the air-tight stove, which will only exhaust enough air for one person, and besides has the very serious fault of giving off into the room the direct products of combustion, and of sending in puffs into the apartment poisonous gases, every time a sudden gust of wind blows down the chimney.

But if air is drawn out of a room, some provision must be made for the introduction of a further supply. In order to accomplish this, dependence is usually placed upon the defects in the construction of the house, by which cold air may be admitted either through the cracks under the doors, or by the side of the windows. This is, however, wrong, since not only is it an insufficient supply, but, passing along the floor, it is apt to cause cold feet. If the house is heated by a furnace, the air taken in by the cold air box, and passed up heated through the registers, will usually furnish the needed supply. The only objection to this method is the usual one, attached to all heating apparatus of this kind ; that is, that iron, heated by direct action of the fire, gives out usually a more unpleasant heat, since it absorbs too much moisture from the atmosphere, and by it the direct production of combustion are carried up into the rooms which it heats.

For heating purposes solely, coils of pipe, through which hot water or steam passes, are preferable to the usual hot air furnace, *provided that the room heated by them is abundantly well supplied with a proper and efficient ventilation.*

Although it is objectionable at times to have the coils of pipe in the living rooms, yet they are a decided improvement upon the ordinary furnace, since by them, the dangers, arising from the transmission of the gases of combustion directly into the room, are obviated. No matter what method of heating is employed, great care should always be taken that the air to feed the fire is not taken from the cellar, nor from a point, from which there would be a possibility of sewer gas being drawn into the cold air box.

If no air supply from furnaces can be depended upon, then it becomes necessary to provide a special contrivance, in the shape of ventilating bricks placed in the upper part of the walls of the room, to admit the requisite amount of air. Ventilation, however, can be assisted by placing a board, five or six inches wide, and equal in length to the width of the window, under the lower sash, which should be opened sufficiently to receive it. This permits the air to enter between the sashes, in a current directly upwards.

In order that no draught may be caused in the room by the special ventilating apparatus, which would induce persons to close the openings, their size should be proportionate to the velocity of the current of air produced by them. Upon this subject, Dr. De Chaumont says: "A current of air at the rate of one and a half to two feet per second—equal to walking through still air at the rate of one and a half miles an hour—can hardly be perceived; but two and a half to three feet per second is distinctly perceptible, while five feet per second would be a decided draught." "Consequently," he says, "the current of air in the room should not have a velocity of more than two feet per second, and should be kept, as nearly as possible, at five feet per second at the point of entrance. Allowing three thousand cubic feet of air per hour for each individual, it would be necessary to have an opening one-sixth of a square foot, or twenty-four square inches, to produce at the point of entrance a current of air of five feet per second. Of course, when air enters, it must have equally as good an opportunity to escape, and consequently the opening for its exit should be, in order to keep up a proper current, of the same size as those for its admission, viz: twenty-four square inches."

Before leaving this subject, I cannot refrain from referring to another, which stands in close relation to it, and that is the temperature of our school-rooms. It is altogether too common for the teachers, finding that the heat has become oppressive, to open the windows at the top, thereby admitting a current of cold

air upon the heads of the children—a practice which causes an increase of colds, bronchial difficulties, or more serious pulmonary affections. Next to overheating, this sudden change of temperature is the most prolific cause of disease. In an experiment undertaken in a building in this city, it was found that this procedure had reduced the temperature of the room at the desk level, in three-quarters of an hour, 16° F., a change which, if it had occurred in the outer atmosphere, would have caused an increased amount of sickness. More dangerous, however, than the admission of cold air, is the ordinary custom of overheating, which is an efficient cause of the languor and depression from which many school children suffer. Therefore it seems proper that some standard should be adopted, by which the heat of the school-rooms should be regulated, and not trust to the feelings of the teacher for the proper temperature; since so many individual idiosyncrasies exist, especially among females, that a temperature which may be comfortable for them, may be altogether too high for the forty or fifty pupils under their charge. Just what this standard should be is somewhat difficult to decide, since opinions vary upon this point. Dr. Bowditch of Boston, who has given much attention to this subject, says that no room is healthy if heated above 70° F. Varrentrap, the eminent German sanitarian, says that a thermometer ten feet distant from the stove, and five feet above the floor, ought not to register over 15° R., (65¾ F.) Morin says: "In well ventilated places, with a constant change of air, higher temperatures can be easily borne, and even be found pleasanter than those which would be found oppressive, where the air is not changed. Nevertheless, the internal temperature should not be kept above the following points:—

Nurseries, asylums and schools,	59 degrees.
Workshops, barracks, prisons,	59 "
Hospitals,	61-63 "
Theatres, assembly-rooms, lecture halls,	66-68 "

"The fresh air introduced should generally have about the temperature it is desired to maintain in the room, as soon as this is sufficiently warmed."

From these different standards deducing an average, I would respectfully suggest that a temperature varrying between 65° and 68° F. is the proper temperature for school rooms, and would urge its adoption.

CHAPTER V.

VARIOUS NUISANCES.

STREETS.

It is a sanitary necessity that streets should be kept clean, and their refuse, which is organic matter in a state of decomposition, should be promptly and properly removed. This can be accomplished with greater facility when streets are paved, and therefore the proper paving of streets demands the attention of sanitary bodies. There are certain portions of our city, notably in the neighborhood of the Haymarket, which, owing to the absence of pavement, are very difficult to keep clean; and I would therefore recommend that the paving of these districts should receive as early attention, as is practicable.

In regard to the proper pavement to be used upon our streets, much discussion has arisen. The primary requisites of any form of pavement are that it should be durable, and of such a material that it will be incapable of imbibing filth or absorbing moisture, and easily kept clean. If it is at all porous, there is great danger that under constant wetting, (as in the case of rains and sprinkling by water-carts), and rapid drying, malarial disorders of some sort may arise. "For producing malaria," says Sir Thomas Watson, "it appears to be requisite that there should be a surface capable of absorbing moisture, and that this surface should be flooded or soaked with water, and then dried; the higher the temperature, and the quicker the drying process, the more plentiful and the more virulent the poison that is evolved."

Apart from the dangers arising from the decomposition of the organic detritus, which fills the interstices between the rows of blocks forming the wooden pavement, and the great tendency for some portion of the pavement to decay, no matter how well treated, dangers of the kind already mentioned are, I am confident, increased by their use. The blocks certainly will and do absorb moisture, and kept constantly wet, as they are during certain seasons

and in certain localities, and rapidly drying, not only give off malarious poisons, but also liberate the gases of decomposition, from the organic matters held in their depressions and interstices. The discontinuance of this form of pavement should therefore be insisted upon, at least for sanitary reasons.

Concrete is another substance which has been employed to some extent in the construction of pavements. If it were possible (and I believe that it is) to procure the pure asphalt, this form of pavement would be very desirable in places where there are no severe frosts; but as this pavement is now made, it is no doubt injurious to health. It is next to impossible, particularly in our cold climate, to prevent the material from being broken up into fine powder, which penetrates houses, settles upon furniture, and affects the air-passages of the occupants. To such an extent did this evil occur in New York, a few years ago, that the Board of Health obliged certain portions of this pavement to be immediately taken up.

The only other practical pavement is the stone block, which, though its original cost is greater, is really much cheaper on account of its durability, and is certainly free from the serious objections attached to the other varieties which have been mentioned. It should therefore be used wherever pavement is laid.

Whatever form of pavement is used, particularly if it is the wooden variety, I believe that hygiene demands that it should be watered less, and swept and scavenged more frequently than it is now done in this city; since the constant watering, which many streets receive, adds too much moisture to the atmosphere. I do not wish to be understood to say that sprinkling the streets is in any manner injurious; on the contrary, I deem it very necessary, but, at the same time, it should be done judiciously, and in connection with thorough sweeping and scavenging, since the mere watering of the streets, important as it is, does not carry off organic particles, but simply prevents their rising. Upon the more important streets, the sweeping and scavenging should be done at night. Whether certain salts could be added to the sprinkling water with advantage, is a question now under advisement by sanitary observers. Eassie says that by watering the road with the deliquescent salts, viz: the chlorides of sodium, calcium and aluminum mixed, the dust is not only laid, but fixed to the ground, and much extra labor and expense, in frequent watering, is consequently saved. "By these salts," he says, "the streets are in a measure

disinfected, and the ammoniacal dust prevented from rising to the level of the pedestrian's mouth."

The importance of a constant and thorough cleaning of the streets cannot be over-estimated, particularly where they are paved with the wooden block, for the dust of the streets is made up mainly of the excrement of horses,* which, if it is allowed to accumulate, being alternately dried by the sun and air, and wet by the rains and watering carts, becomes a decomposing mass, which, by its gases and solid particles diffused through the air, is highly injurious to health. For these reasons, the interests of the public health demand that the streets, particularly in the summer and autumn, should be cleaned much more frequently than is now the custom; and as the scavenging of public ways is undertaken for sanitary reasons, it would seem eminently proper that the Board of Health should have supervision over it, as this Board is directly responsible for the public health.

SWILL, GARBAGE AND ASHES.

Of more importance perhaps than the condition of the streets, is that of the yards connected with dwellings, since they are in such close relation with the house, that the effects of any filth deposited in them is more readily felt. The refuse, which is usually deposited in these yards, consists of ashes, swill and garbage, which under the present ordinances governing these articles form, I believe, a very prolific source of filth. These ordinances provide that no ashes shall be mingled with the swill and garbage, (the very means which would tend to render them inoffensive), and that they shall be removed by the contractor not less than two times a week, during the months of May, June, July, August, September and October, and as many times oftener as may be necessary to prevent the swill deposited from becoming offensive; and not less than once a

* By an examination made of the street and road dust, under the direction of the New York Board of Health, the following was found to be its composition:—"The dust of the streets, in its finer or coarser particles, according to the height at which it had been collected, was mixed with a large proportion of organic elements, particles of sand, quartz and feldspar; of carbon from coal-dust and lampblack; fibres of wool and cotton of various tints; epidermic scales; granules of starch of wheat, mainly the tissues of plants; the epidermic tissue, recognized by the stomata; vegetable ducts and fibres, with spiral markings; vegetable hair or down, either single or in tufts of four or eight, and of great variety, and three distinct kinds of pollens. Fungi were abundant, from mere microscopic granules to filaments of mould. When water was added to a portion of dust from any source, and exposed in a test tube to sunlight or heat for a few hours, vibriones and bacteria made their appearance, and the fungous elements sprouted and multiplied, showing that they maintained their vitality, and proving that the germs of fermentation and putrefaction are very widely diffused."

week during the balance of the year, *upon notice from the householder being sent to him.* By another section, every householder is obliged to provide water-tight receptacles for the swill and garbage, which may accumulate during *forty-eight hours.*

To the discrepancy, existing between the last section and the one which precedes it, I desire to call the attention of your Board. This discrepancy consists in the fact, that by one ordinance a receptacle for the swill and garbage is provided for only forty-eight hours' accumulation; while by the other it is only necessary that this refuse should be removed once in three days and a half in summer, and once in seven days in winter. Under these circumstances, the receptacle provided by law must soon overflow, and a nuisance thereby be created.

Although it is eminently proper that an admixture of ashes with the swill should be prohibited, on account of the value of the latter class of refuse, yet, deprived of the best of disinfectants (dry ashes), it soon decomposes, particularly in warm weather; and if exposed to the rain and sun, a two-days' retention of it becomes offensive and a nuisance. I would therefore respectfully suggest, that it be made obligatory upon every householder to provide not only a water-tight receptacle for swill and garbage, capable of holding the requisite amount, but also to protect the contents of such receptacles from the rain and sun. As last year only five hundred and thirty persons, more or less, requested the removal of this class of refuse, I would still further recommend that householders be compelled either to burn this refuse, or have it removed by the contractor, unless by special permission of the Board of Health; and that this removal should take place not less than three times a week in summer, and twice a week in winter, or oftener as it becomes necessary.

As it is almost impossible to prevent house refuse of all sorts being thrown on to the ash pile, where it is exposed directly to the sun and rain, thereby favoring its decomposition, and as no ordinance exists which provides for the removal of ashes, I would suggest that a law be passed, compelling this class of refuse to be also kept in water-tight receptacles, and providing for its more systematic removal than is done at the present time. Such an ordinance would prevent the ashes from being scattered about the premises, or thrown out, as too often happens, into the streets and alleys.

SMOKE.

One of the most common nuisances in this city is that caused by smoke; since, although it may not be highly detrimental to health, yet it is at least disagreeable and offensive to many. So great has this nuisance been considered in all large coal-consuming communities, that many plans have been suggested for its abatement. Smoke-ridden England alone has, within the last twenty years, granted no less than four hundred and fifty patents for its prevention, and yet much is still left to be done. The most important object to be accomplished is, not only to consume the smoke, but to *prevent* the *poisonous gases of combustion* to be diffused through the atmosphere, since it has been proven "that if there is a more perfect combustion, if no smoke nor unconsumed carbon were to escape from our chimnies, we should be worse off than ever, unless we resorted to the use of enormous chimnies, to take up the carbonic and sulphurous acid gases to a height, where they would be diluted as fast as they left the summit. In other words, the carbon, the soot, the smoke would prove less noxious than the poisonous gases, which would in that case descend from the chimnies and deteriorate our immediate atmosphere."

The most successful plans which have as yet been devised for the prevention of smoke are as follows:

By a nicer regulation of the supply of fuel, by which the smoke is compelled to repass the fire, to be consumed.

By the injection of air or steam into the flues or upon the fuel itself. A Mr. Ivison of England projected a stream of steam between the fire and the boiler, the heat decomposing the steam, and causing the liberated oxygen to unite with the carbon of the smoke.

Mr. Sicardo, in 1865, projected a plan which has been employed with advantage. By it the smoke, instead of passing up the chimney, was driven by an "air separating fan" into a twin pipe, the smaller and lower part of which conveyed the smokeless air to the chimney, the upper and larger one taking the smoke, etc., to a reservoir, from which it was borne, with a quantity of exhaust steam, to the under side of the fire grate.

By altering the different parts of the furnace, so that, for instance, smoke-distributing pipes are made to perforate the bridge of the furnace, and being heated red-hot, the combustion of the smoke takes place in them in its passage through.

Other devices have been suggested in this country, such as increasing combustion by throwing minute sprays of water upon the fire, and by inserting flanges or fans into the chimney to catch the smoke and soot, which can be removed through apertures provided for the purpose. As yet, however, no one plan has been considered entirely satisfactory, though many have been proven to be partially successful.

In furtherance of this object, since it would materially add to the comfort of the community, I would suggest the appointment of a committee to inquire into, and to report upon the best means for abating this nuisance.

ACID WORKS AND REFINERIES.

A graver evil still than the smoke which pervades the atmosphere, is that which grows out of the noxious and offensive vapors which, from time to time, are wafted over the city from the acid works and refineries. The emanations from these establishments have always been a nuisance of the worst kind, both from their offensiveness and from the positive impairment to health, which some of them, particularly those which arise from the acid restoring works produce. The process of restoring these acids is as follows:—

The spent acid is mixed in large wooden tanks, lined with sheet lead, say, with about one-half to two-thirds water to one part of acid. This separates the oil and carbonaceous matter from the mixture. When clear, it is drained off into large leaden pans to evaporate the water, and to bring it up to 63° F., and when cooled down somewhat, it is passed into glass stills and concentrated to 66°. The acid used in the pans contains carbon in solution, and when concentrated, one atom of carbon decomposes two atoms of sulphuric acid, by uniting with two atoms of the oxygen from the sulphuric acid to form carbonic acid. The gases thrown off consist in greater part of sulphurous acid, carbonic acid and a compound of garlic smell, which is the sulphuret of organic matter.

These emanations, consisting mainly of acid gases, which are cast off to some extent by all acid works, are extremely offensive and irritating to the respiratory passages, and consequently some measures should be taken to prevent this evil. Various plans have been suggested by which these fumes may be treated, so that they shall not be diffused through the atmosphere. But none seem to promise so much relief as that which is prescribed in

England, by act of Parliament, to be used in alkali establishments which deal with acids. By this method the acid fumes are lead by a flue into a tower (called a "scrubber"), which is sixty feet in height, and filled with coke or bricks, moistened with water kept constantly trickling from a tank placed above it. Passing up this tower, the fumes meet the descending current of water, which is made to spread over a larger surface by the coke or bricks. The dilute acid runs away by a pipe at the base of the tower, whilst the unabsorbed fumes and products of combustion pass down a brick tunnel into a second tower, into which they ascend and meet another current of falling water. When the vapors reach the top of this tower, they are to a great extent free from gas, and are allowed to pass through a stoneware pipe to a chimney.*

This plan, so successfully employed in England in alkali works, would seem to be perfectly applicable to any establishment from which acid vapors are given off, and particularly, since water is capable of absorbing forty-four times its own volume of sulphurous acid, to those from which this acid-gas escapes.

If the works are small, one tower would probably be sufficient to absorb the greater portion of the gas. Even in those processes which necessitate the use of open evaporating pans, this gas might be led from a hood or cover placed over these pans, through a tower of large diameter (not necessarily very high) to cause a good draught, into the chimney. The strong draught thus created would undoubtedly be strong enough to carry almost all the vapors through the tower.

This matter is so important—affecting as it does such large numbers of the community—that I earnestly urge your careful attention to it, and the adoption of some method which will free the city from this nuisance. As the largest acid-restoring works are outside the city limits, having been removed there by order of a former Board of Health, whatever is done with this establishment, at least, must be done amicably, since over it now the city has no jurisdiction. With all acid works, however, whether outside or inside the

* By act of Parliament, the alkali makers are compelled to condense at least ninety-five per cent. of the hydrochloric acid gas they produce; and so perfect is this condensation, as a rule, carried out, that the escaping gases do not cause a turbidity in a solution of nitrate of silver, proving the absence of even a trace of the acid gas.

corporation, from which offensive emanations proceed, some agreement should be made, by which an approved plan may be given a fair trial.

The emanations from oil refineries, although not directly prejudicial to health, yet are oftentimes exceedingly offensive, and, by their offensiveness, in certain cases indirectly affect the well-being of individuals, by the headache, nausea and loss of sleep which are produced. In consequence of this, I would ask your attention to some method by which this nuisance may likewise be abated.

The cause of the disagreeable odors from this source, which are diffused through the atmosphere, arises from the treatment of the oil, which at a certain temperature "cracks," whereby is liberated probably an essential oil, having an extremely strong, and to most persons an offensive odor. To prevent the liberation of this essential oil, gas or compound, whatever it may be, a patent has been issued to a Mr. Tweddle of Pittsburgh, Penn., for a process, by which the petroleum is heated in *vacuo* to a point short of cracking, and consequently short of the production of any odor. Since this process is especially applicable to the manufacture of the heavier lubricating oils, it is doubtful whether it would be of service in the production of the lighter ones for illuminating purposes; and as it would involve a radical change in the present process of refining, as carried on in this city, it cannot be recommended.

Whatever means may be adopted to prevent the offensive odors of refining, it must be some process, it seems to me, by which either the emanations may be caught and destroyed, or neutralized by some chemical action. As it has been impossible to arrive at any conclusions upon this point, by the letters which I have addressed to various chemists and scientific men, I would respectfully suggest that a committee be appointed at an early day, to thoroughly investigate this whole subject, with a view of abating the evil.

RENDERING AND TRYING ESTABLISHMENTS.

Although the emanations from these establishments cannot be said to be injurious to health, yet there is no doubt that they are exceedingly offensive, and should therefore be prevented.

"Trying out the rough fat, even while fresh and sweet," writes Hon. Jackson S. Schultz, late United States Commissioner at the Vienna Exhibition, who investigated the subject very thoroughly when in Europe, "*is* offensive; and this offence induces the closing of our doors and windows, thus shutting out the fresh, pure air of heaven, to which all are entitled. And it is the duty of Boards of Health to prevent the practice, particularly as it is now demonstrated that the offensive gases from this boiling fat can be overcome, if not destroyed, at a very inconsiderable cost."

The means, which have already been adopted in most of the establishments of this nature in the city, have been partially successful; still there are certain offensive emanations which continue to escape from the chimnies, but which, by a further extension of the process of destruction, might be prevented, and the blood, which now flows into the Run, be otherwise disposed of.

The best plan for the furtherance of this object, is, as far as can be learned, the following, which is employed in the Brighton Abattoir: "After the rendering tanks are filled, the openings are closed, and the contents cooked by steam. After sufficient cooking, the contents are dropped out of the tanks by openings at the bottom of them. Here the fat is separated from the watery part, and from the scraps and tankings, which latter portion is put into the driers. *The blood from the slaughter houses is also here put into the driers.* The water is evaporated by the steam-heat, and the residuum comes out as dry, animal matter. This is passed through a mill and ground to powder. From the mill the powder drops into barrels, and is packed for market. *By an ingenious system of pipes, the steam and offensive gases from the rendering tanks and driers are passed through a condensing apparatus, where the steam becomes water, and the remaining gases are then mixed with the common air,* and by means of a blower are forced down and under the fires of the steam-boilers. After being thus purified by fire, they are finally discharged through a chimney one hundred and sixty feet high. The rendering process thus conducted gives no odor. There is nothing offensive about the fertilizer, and what slight odor it possesses is wholly imperceptible after it is packed." *

HORSE CARS.

The unhealthy condition of the cars upon some of the horse railroads of the city demand your early attention. During the cold months of the year

* Report of the Butchers' Slaughtering and Melting Association.

the floors are covered with straw, which soon becomes wet, thus filling the car with damp, unhealthy emanations, which can be nothing but highly injurious to health. The prevalent custom of over-crowding the cars is likewise exceedingly detrimental, particularly to delicate organizations, and should therefore be promptly prohibited; since such a large number of persons crowded together within a small space, with insufficient ventilation, soon exhausts the pure air, and supplies its place with the emanations from the lungs, skin and clothing.

I would therefore recommend that the various Street Railway Companies be obliged either to remove the straw in their cars altogether, or to renew it often enough to keep it reasonably dry and clean, and to provide a better system of ventilation, and that the Health Department should for this purpose have supervision over them. I would also recommend that an ordinance be passed, prescribing the number of passengers which each car shall carry.

That the cars should be heated does not seem expedient, since, with the present ventilators and windows closed, and the car filled with passengers, the temperature would in all probability be kept too high and the air still further vitiated, thus adding to the dangers of taking cold.

PEST HOUSE.

This institution is located a long distance from the city. To reach it, it is necessary to travel over roads which, at certain seasons of the year, are all but impassable, and often so rough that the jolting and jarring which a patient receives, in his transportation over them, seriously lessen his chances for recovery. In fact, deaths have occurred which have been directly attributable to this cause; and if this should happen to one who could bear the expenses of a law suit, the city would undoubtedly be compelled to pay damages. I would therefore recommend the early abandonment of this Hospital, and the procuring of one situated nearer to the city, and more easily accessible.

DISTRICT RELIEF TO THE POOR.

The present system of affording relief to the poor of this city, which, as is known to you, consists in the appointment of six district physicians at certain salaries, from which they provide the necessary drugs and appliances, is, although excellent in its design, defective in many particulars. To carry it

out successfully, it is necessary in certain cases to provide separate offices for the physicians, for which rent is paid; while in other cases, the patients are obliged to visit the physicians' private offices. Furthermore, under the present plan, the physicians are obliged to furnish out of their salaries all the medicines and apparatus which may be required. This is objectionable, since at certain times, when there is much sickness, it may be necessary for them to expend the greater portion of their pay to provide what is necessary to render their treatment successful. Consequently the more sickness there is, the less they receive.

To obviate these defects, I would suggest that a central Dispensary, or one on each side of the river, be established, to which all the poor who are able should be obliged to come for treatment. The rent for the necessary rooms need not exceed that which is now paid for the physicians' offices.

For the necessary medical attendants, it would be possible, as in many other cities, to appoint physicians without pay, who would receive their recompense in the experience which might be derived from this practice, from the reputation which would result to them, and from the opportunity which would arise for clinical teaching to the many students, who annually visit the city for medical instruction.

For the treatment of all those who are unable to visit the central Dispensary, I would recommend that, as at present, district physicians should be appointed, who should receive a certain definite salary, from which however no drugs nor appliances should be furnished, such being dispensed to all city patients from the central Dispensary, or from certain reliable drug-stores in the districts in which the patient resides. Arrangements could be made with such stores to furnish the needed articles at greatly reduced rates.

SANITARY FORCE.

Owing to the peculiar condition of the city, with its population scattered over a large area, many wards being but little more than suburbs, but over which the city has jurisdiction, and owing to the fact that a large number, not only among the lower but the upper classes of inhabitants, cannot be trusted to keep their premises in a good sanitary condition, requiring notices to abate nuisances to be served upon them, and in many cases to be narrowly watched to see that the notices are obeyed, a much larger sanitary force than the

present one is needed. I would therefore suggest that, as in winter a thaw is liable to happen at any time, flooding yards and privies, and revealing nuisances, the number of sanitary police should at no time be reduced below six, and from the first of April to the first of December increased to twelve men.

In presenting this Report to you, it has been far from my intention to overdraw the picture of the existence of what is known as filth, or of its relation to disease; but actuated by an earnest desire to improve the sanitary condition of our city, and thereby lessen its death-rate, I have desired to call your careful attention to the undoubted fact, that filth does exist, even in its most glaring forms, much more frequently than our ancestors, or perhaps even we ourselves have imagined, and that in this, the nineteenth century, neither individuals nor communities can afford to ignore the fact that they are in a great degree responsible for their own health. Just in proportion as this fact is lost sight of, just as surely as we disobey any of the hygienic laws, just so surely will disease continue to prevail, to the detriment not only of our own health, but of that of our descendants, to whom we are morally responsible for our neglect of sanitary precautions. Communities are easily aroused to the realization of their danger at the time of such a severe epidemic as has recently visited our city; but, like the horrors of an Ashtabula or New Hamburg disaster, the lessons to be learned from such an outbreak are soon forgotten. If this should occur at the present time, if we should consign to the dim memories of the past all recollection of our ability to stamp out certain diseases, we must be held accountable. Is it not better therefore to heed the "hand-writing on the wall," and by sanitary reform to prevent, as far as lies in our power, the possibility of another epidemic?

CONCLUSION.

In conclusion, I desire to express my thanks to your Honorable Board, for your courtesy in granting to me, last summer, a long leave of absence; to the District Physicians, for the skill and ability which they have displayed during the past year; to the Secretary and Assistant Secretary, for their readiness to aid me in my work; to the Sanitary Police, for their energy and strict attention to their duties; and to the Members of the Regular Force, for their valuable assistance in detecting and reporting various nuisances.

Respectfully,

FRANK WELLS, M. D.,

Health Officer.

STATISTICAL TABLES.

TABLE I.—*Actual Mortality from the Principal Causes of Deaths, by Months, for the Year 1876.*

POPULATION OF CLEVELAND, 162,000.

CAUSES OF DEATH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total for 1876.	Death-Rate per 1000.	Percentage of each cause on Total.
Total Deaths from all Causes	275	220	214	243	197	191	358	339	381	255	317	237	3,227	19.90	.....
" Zymotic Diseases	60	55	50	36	38	32	141	160	193	108	107	82	1,062	6.55	32.91
" Constitutional Diseases	45	42	43	44	42	34	39	45	63	36	42	25	500	3.08	15.43
" Local Diseases	80	76	74	94	78	68	106	110	112	62	113	77	1,050	6.48	32.53
" Developmental Diseases	47	42	34	48	22	33	37	33	45	37	38	25	441	2.72	13.66
Deaths by Violence	8	5	5	6	8	11	7	8	10	7	11	4	90	.55	2.78
Not Stated	7	6	6	3	6	2	11	16	15	4	1	7	84	.52	2.60
Small-Pox	2	4	1	1	4	.....	1	.....	.....	.....	.....	.....	13	.08	.43
Measles	2	3	1	3	4	1	.....	.....	.....	.....	.....	.....	14	.08	.46
Scarlatina—Minors	11	8	1	1	4	5	4	.....	1	5	1	2	43	.26	1.33
" Adults	.....	.....	.....	.....	1	1	.....	.....	.....	.....	3	.....	5	.03	.15
Diphtheria—Minors	36	21	23	15	7	7	11	12	54	59	82	61	388	2.39	12.02
" Adults	5	1	1	1	.....	.....	1	1	4	3	.....	3	20	.12	.62
Membranous Croup	3	2	1	.....	1	2	2	.....	2	3	9	1	26	.16	.80
Whooping Cough	4	6	5	4	.....	5	.....	1	6	1	1	.....	34	.20	1.05
Typhus Fever	1	.....	.....	.....	1	1	.....	3	2	.....	.....	1	9	.05	.27
Typhoid Fever	5	2	4	2	3	1	2	7	16	18	3	6	69	.42	2.13
Puerperal Diseases	1	.....	1	1	1	.....	1	1	1	1	1	2	11	.06	.34
Diarrhœal Diseases—Under 5 years	.....	2	1	.....	1	4	78	43	31	4	3	.....	167	1.03	5.11
" " All ages	4	6	3	3	3	9	118	106	75	9	9	2	347	2.14	10.75

TABLE I.—Continued.

Causes of Death.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total for 1876.	Death-Rate per 1000.	Percentage of each cause on Total.
Alcoholism				1		2	2	2	1			2	10	.06	.30
Cancer	4	1		8	7	3	1	3	1	6	3	1	36	.22	1.11
Phthisis Pulmonalis	28	22	26	33	25	30	20	20	20	17	20	11	272	1.67	8.42
Bronchitis	4	8	5	3	3		1	1		1	6	2	32	.19	.99
Pneumonia	8	10	13	16	10	6	6	5	5	2	14	5	110	.67	3.40
Heart Disease	5	3	4	10	9	9	10	10	1	7	8	3	79	.48	2 44
Marasmus, Tabes Mesenterica and Scrofula	3	3	3	3	1	4	11	11	15	5	6		65	.40	2.01
Hydrocephalus and Tubercular Meningitis	5	2	1	1	1		1	1	3	1	1	2	19	.11	.58
Meningitis and Encephalitis	1	2	6	6	5	8	14	13	9	5	5	5	79	.48	2.44
Convulsions	16	20	20	19	14	18	30	22	24	16	24	14	237	1.46	7.34
Direct Effect of Solar Heat						1	1						2	.01	.06
Apoplexy	6	5	5	4	1	2		2	2	3	4	3	37	.22	1.14
All Diseases of Brain and Nervous System	11	9	12	9	12	11	12	17	18	7	7	8	123	.75	3.81
Bright's Disease and Nephritis	3	4	2	3	1		1	1	5		2	2	21	.12	.65
Deaths by Suicide	2			2	2	3	1	3	1	1	1	1	17	.10	.52
" " Drowning				1	3	6	7	5	3		1		26	.16	.80
" in Institutions	3	7	9	12	12	10	10	16	8	8	11	4	110	.67	3.46
" of Persons 70 years old and over	19	3	18	24	15	13	13	14	11	12	13	16	181	1.11	5.60
" " Children under 1 year of age	80	71	82	88	57	62	194	171	132	61	102	56	1,106	6.76	34.24
" " " " 2 years of age	95	92	95	102	68	73	217	224	195	83	126	75	1,395	8.61	43.22
" " " " 5 years of age	135	118	114	122	89	83	229	230	214	128	174	113	1,719	10.61	53.26

TABLE II.—*Actual Mortality during the Twelve Months ending December 31st, 1876.*

BY WARDS.

WARDS.	DEATHS FROM ZYMOTIC DISEASES. Deaths from Small-Pox, Measles, Scarlatina, Diphtheria, Whooping Cough, Typhoid Fever, Typhus Fever, Cholera, Cholera Infantum, Diarrhœal Maladies, and other Zymotic Diseases.													DEATHS IN PUBLIC INSTITUTIONS.											
	Small-Pox.	Measles.	Scarlatina.	Diphtheria.	Croup.	Whooping Cough	Typhus Fever.	Typhoid Fever.	All Diarrhœal Diseases.	Cerebro-Spinal Fever.	Other Zymotic Diseases.	Total Deaths from Zymotic Diseases.	Total Deaths from all Causes.	Total Deaths, exclusive of those in Public Institutions.	Total Population (in Wards). Census of 1870.	City Infirmary.	Charity Hospital.	City Hospital.	Workhouse.	Trinity Home.	St. Mary's Asylum.	Huron Street Hospital.	St. Joseph's Asylum.	Monroe Street Orphan Asylum.	Industrial School.	Little Sisters of the Poor.	Jewish Orphan Asylum.
First		1	2	31				4	18	1	7	54	202	200	8,580							1			1		
Second				32	2	3		6	17	2	2	54	215	206	5,680			9									
Third			1	3		2	1		5		4	16	70	70	3,290												
Fourth		3	5	23	2	4		7	29		7	60	356	299	9,850		54			1	1				1		
Fifth		1	3	27	3	2	1	5	21		2	65	196	194	9,725								2				
Sixth			5	21				12	23	1	5	67	238	237	13,324												1
Seventh			6	21		2		4	39		4	76	166	166	5,658												
Eighth		1	1	37		5		4	27	1	6	82	216	216	5,416												
Ninth			4	22	2	1		5	14			48	104	104	5,940												
Tenth			1	74	6	1	1	4	27		2	116	257	257	6,590												
Eleventh		3	1	27	1			5	16			53	199	198	8,059									1			

TABLE II.—Continued.

Wards.	Deaths from Zymotic Diseases. Deaths from Small-Pox, Measles, Scarlatina, Diphtheria, Whooping Cough, Typhoid Fever, Typhus Fever, Cholera, Cholera Infantum, Diarrhœal Maladies, and other Zymotic Diseases.													Deaths in Public Institutions.										
	Small-Pox.	Measles.	Scarlatina.	Diphtheria.	Croup.	Whooping Cough.	Typhus Fever.	Typhoid Fever.	All Diarrhœal Diseases.	Cerebro-Spinal Fever.	Other Zymotic Diseases.	Total Deaths from Zymotic Diseases.	Total Deaths from all Causes.	Total Deaths, exclusive of those in Public Institutions.	Total Population (in Wards). Census of 1870.	City Infirmary.	Charity Hospital.	City Hospital.	Workhouse.	Trinity Home.	St. Mary's Asylum.	Huron Street Hospital.	St. Joseph's Asylum.	Monroe Street Orphan Asylum.	Industrial School.	Little Sisters of the Poor.	Jewish Orphan Asylum.
Twelfth	3	1	2	16	2	2	....	6	17	....	4	53	175	175	3,812											
Thirteenth			2	28	4	1	...	8	30	....	5	78	175	129	3,687	46										
Fourteenth		1	....	11	3	1	...	2	27	....	2	47	143	143	1,538											
Fifteenth			2	6	1	1	....	3	14	...	2	29	103	102	1,801				1							
Sixteenth			2	7				1	8			18	43	43	5,550											
Seventeenth			2	7				...	14			23	61	61	2,180											
Eighteenth	1	1	2	6	1	2	...	4	21	...	2	40	152	152	6,227											
Not Stated			1					2	2	....	2	7	56													

TABLE III.—*Nativity of Persons who Died during the Year ending December 31st, 1876.*

Austria.	British America.	England.	Europe.	France.	Germany.	Holland.	Ireland.	Italy.	Poland.	Russia.	Scotland.	Switzerland.	United States.	Wales.	City.	Unknown.	Total.
55	37	128	3	9	325	7	215	5	5	1	15	14	490	19	1,868	31	3,227

TABLE IV.—*Births Reported during the Year ending December 31st, 1876.*

DATE.	Total.	COLOR.		SEX.			NATIVITY OF PARENTS.				AGE OF PARENTS.																				
											FATHER.										MOTHER.										
		White.	Colored.	Male.	Female.	Not Stated.	Foreign.	Native.	Foreign Father only.	Foreign Mother only.	Not Stated.	15 — 20	20 — 25	25 — 30	30 — 35	35 — 40	40 — 45	45 — 50	Over 50.	Not Stated.	15 — 20	20 — 25	25 — 30	30 — 35	35 — 40	40 — 45	45 — 50	Over 50.	Not Stated.
January	294	292	2	171	123	....	200	56	9	29	.....	34	74	69	63	26	8	2	15	10	77	66	66	43	16	1	1	14
February	251	249	2	133	116	2	191	34	5	21	.....	29	57	65	52	18	10	4	12	12	71	60	52	33	13	2	..	8
March	299	298	1	176	123	....	145	43	22	27	4 ..	40	66	79	57	28	11	4	14	12	76	74	69	50	15	.....	..	3
April	241	241	....	127	110	4	169	37	9	26	.....	29	61	59	44	19	13	12	4	11	69	74	37	29	15	3	..	3
May	301	301	....	156	138	7	207	49	17	28	.....	26	63	74	62	43	8	6	19	16	70	72	63	50	16	2	..	12
June	283	281	2	150	134	3	200	41	9	31	.....	22	59	85	55	34	6	5	15	11	68	78	63	41	10	1	..	9
July	312	312	....	163	146	3	220	42	7	43	.....	33	80	73	57	29	13	8	19	24	71	83	58	50	12	1	..	12
August	463	457	6	234	223	6	316	81	16	44	5 ..	57	119	109	77	50	19	7	25	30	123	119	98	46	25	1	..	19
September	465	464	1	239	224	2	310	86	20	40	10 ..	54	121	129	79	39	18	5	20	19	123	147	89	45	19	3	..	20
October	468	465	3	261	206	1	315	69	17	53	9 1	40	124	122	81	49	20	6	16	22	124	139	77	63	29	1	..	13
November	478	473	5	246	232	....	264	103	19	53	1 ..	43	126	124	84	49	24	6	19	23	126	135	79	65	30	2	..	8
December	421	418	3	225	196	....	269	81	7	40	2 ..	36	103	111	90	46	12	10	15	22	93	121	93	65	20	5	..	4
Total	4276	4251	25	2282	1981	28	2806	722	148	415	31 1	443	1053	1099	801	430	162	75	196	212	1091	1168	844	580	220	22	1	125

TABLE V.—*Meteorological Observations, taken at the Signal Office, Cleveland, Ohio,*
By GEO. PRENDER, Observer, Sergeant Signal Service, U. S. A.

DATE.	BAROMETER.							THERMOMETER.							WIND.		AMOUNT OF RAIN AND MELTED SNOW		NUMBER OF AURORAS.
	MEAN.	MEAN OF—			RANGE.			MEAN	MEAN OF—			RANGE.			PREVAILING DIRECTION.	NO. MILES. Maximum velocity during month.	NO. MILES. TOTAL.	Amount in Inches.	Number of Days on which rain or snow fell:
		A. M. observation.	P. M. observation.	Night observation.	Highest.	Lowest.	Difference.		A. M. observation.	P. M. observation.	Night observation.	Maximum.	Minimum.	Difference.					
1876.																			
January	30.073	30.104	30.063	30.066	30.613	29.374	1.239	°35	°32.4	°37.4	°35.1	°69	° 6.4	°62.6	S.	47	10,175	3.72	20
February	30.053	30.097	30.022	30.074	30.769	29.321	1.448	30.2	27.4	33.6	29.6	60.8	4.2	56.6	W.	38	8,341	4.10	19
March	29.993	30.020	29.959	30.005	30.567	29.100	1.467	31.6	28.5	34.2	30.8	73	19	54	W.	53	9,001	2.88	23
April	30.007	30.002	29.977	30.007	30.447	29.347	1.100	43.1	42	46.6	42.3	74	23.1	50.9	W.	42	6,936	1.77	16
May	30.012	30.020	29.996	30.009	30.346	29.679	0.667	56.5	54.5	59.7	55.8	87	28.3	58.7	N.	43	5,432	4.43	17
June	29.925	29.931	29.948	29.921	30.117	29.553	0.564	69.8	67.2	73.7	67.4	87.2	48.8	38.4	S.	28	6,020	3.21	16
July	29.982	30.002	29.951	29.988	30.180	29.772	0.408	72.9	70.2	76.5	70.5	91.3	50.1	41.2	N.	33	5,510	3.04	18
August	30.034	30.062	30.007	30.033	30.254	29.702	0.552	70.5	67.2	74.4	67.7	86.2	45.6	40.6	N.	22	4,377	4.03	12
September	29.965	29.980	29.945	29.973	30.249	29.680	0.569	60.2	57.6	63.4	59.2	78	40	38	N.	44	6,036	5.83	19
October	29.962	29.976	29.944	29.965	30.416	29.405	1.011	47.8	43.9	51.6	46.6	75	26	49	S.W.	32	9,163	3.47	17
November	29.967	29.988	29.945	29.973	30.347	29.415	0.932	40.4	39.2	42.5	39.4	71	20	51	S.W.	36	7,245	2.56	19
December	30.046	30.079	30.027	30.042	30.548	29.331	1.217	21	17.3	22.4	19.7	45	−5	50	S.W.	44	9,512	2.16	25
Total																	87,748	41.20	221
Annual means	30.002	30.022	29.982	30.005	30.404	29.473	0.931	°48.25	°45.62	°51.33	°47	°74.8	°25.54	°49.25	N.	38.5	7,312	3.433	18.4

TABLE VI.—*Showing Weekly Means of Barometer, Thermometer, and Humidity; amount of rain-fall, prevailing direction of wind, average amount of clouds, total wind velocity, prevailing state of weather, and maximum and minimum temperature for 1876.*

1876. Week Ending.	Mean Weekly Barometer.	Mean Weekly Thermometer.	Mean Weekly Humidity.	Rain-fall in inches.	Prevailing direction of Wind.	Average amount of cloudiness.	Weekly Velocity (total) of Wind.	Prevailing State of the Weather.	Maximum Temperature.	Minimum Temperature.
January 1	30.007	°46.6	76.8%	0.48	S.	2-4	1,626	Fair	°69.0	°24.3
January 8	30.130	40.1	61.4	.19	S.	2-4	2,207	Cloudy	66	24.2
January 15	30.109	25.8	79.4	.77	S.	4-4	2,787	Cloudy	59.8	6.4
January 22	29.870	37.1	85.1	.79	S.	3-4	2,148	Cloudy	58.3	22.3
January 29	30.023	34.8	79.5	1.97	W.	3-4	2,037	Cloudy	57	18.5
February 5	30.060	21.7	82.8	.51	S. E.	2-4	1,991	Fair	47	4.2
February 12	30.056	40.8	80.5	2.62	S.	3-4	1,809	Cloudy	58	25
February 19	29.892	33	74.4	.16	S.W.	3-4	2,188	Light Snow	60.8	20
February 26	30.132	25.9	82.7	.12	S. E.	3-4	2,110	Cloudy	44.5	4.9
March 4	30.182	26.9	86.4	.91	N.W.	2-4	1,624	Clear	42.5	13.8
March 11	29.980	47.3	68.1	.23	S.	3-4	2,107	Cloudy	73	26.9
March 18	30.012	26.1	87.4	.85	S.W.	3-4	2,323	Light Rain	62	9
March 25	29.949	27.7	85.4	.86	W.	3-4	1,900	Light Snow	43.2	8.1

TABLE VI.—Continued.

1876. Week Ending.	Mean Weekly Barometer.	Mean Weekly Thermometer.	Mean Weekly Humidity.	Rain-fall in inches.	Prevailing direction of Wind.	Average amount of Cloudiness.	Weekly Velocity (total) of Wind.	Prevailing State of the Weather.	Maximum Temperature.	Minimum Temperature.
April 1	29.898	°28.2	84.8%	.82	W.	4-4	2,202	Light Snow..	°35	°19.1
April 8	30.019	38.8	63.8	.30	W.	1-4	1,768	Clear.....	55	23.1
April 15	29.851	47	64.2	.88	E.	3-4	1,589	Cloudy.....	71	25
April 22	30.071	43.7	62	.22	W.	2-4	1,608	Fair.....	74	31.8
April 29	30.013	46.4	67.3	.37	N.	2-4	1,511	Cloudy.....	66	30.8
May 6	29.997	46.6	67	.33	N.	3-4	1,299	Cloudy.....	64	28.3
May 13	29.981	50.4	69.2	.23	N. W.	3-4	1,264	Cloudy.....	71	40.2
May 20	30.062	61.4	74.8	2.63	N. E.	3-4	1,346	Fair..	84	36.2
May 27	30.070	58.4	61	1.23	N.	1-4	1,079	Clear.....	80	37.4
June 3	29.870	68.6	68.1	1.39	S. W.	2-4	1,311	Hazy.....	87	51.9
June 10	29.982	68.3	63.7	.45	N. W.	1-4	1,567	Clear.....	86	53
June 17	29.919	72.8	65.1	.41	S. E.	2-4	1,389	Fair.....	87.2	62
June 24	29.901	65.6	62	.09	W.	2-4	1,647	Fair.....	82.2	48.8

TABLE VI.—Continued.

1870. Week Ending.	Mean Weekly Barometer.	Mean Weekly Thermometer.	Mean Weekly Humidity.	Rain-fall in inches.	Prevailing direction of Wind.	Average amount of Cloudiness.	Weekly Velocity (total) of Wind.	Prevailing State of the Weather.	Maximum Temperature.	Minimum Temperature.
July 1	29.895	°71.5	68.1	1.26	N. W.	3-4	1,014	Fair	°84.8	°56.4
July 8	29.935	75.4	71.2	1.10	S.	2-4	1,663	Clear	82.2	60
July 15	29.992	75.6	74.7	.46	N.	2-4	816	Fair	88	67.8
July 22	30.025	74.4	70.5	.45	N.	1-4	1,129	Clear	91.3	52.4
July 29	30.006	66.7	66.5	.77	N. E.	2-4	1,411	Fair	83.4	50
August 5	30.040	71	71.9	1.67	N. E	2-4	1,120	Fair	82.5	57.9
August 12	30.103	72.7	76.3	.24	N.	2-4	956	Fair	86.2	55
August 19	29.936	72.6	76.3	1.66	N.	1-4	790	Clear	85	61
August 26	30.041	68	65.3	.46	S. E.	1-4	1,135	Clear	85	48
September 2	30.003	65.9	69.6	.14	N.	2-4	1,120	Fair	86.2	45.6
September 9	29.999	62.8	72.1	.14	N.	3-4	1,157	Cloudy	76	45.9
September 16	30.003	59.4	80.4	1.40	N.	3-4	1,168	Cloudy	76	45
September 23	29.902	62.3	82.6	3.07	E.	4-4	1,393	Cloudy	78	52
September 30	29.955	55.3	70.9	1.18	S. W.	3-4	1,884	Cloudy	72	40

1876. Week Ending.	Mean Weekly Barometer.	Mean Weekly Thermometer.	Mean Weekly Humidity.	Rain-fall in inches.	Prevailing direction of Wind.	Average amount of Cloudiness.	Weekly Velocity (total) of Wind.	Prevailing State of the Weather.	Maximum Temperature.	Minimum Temperature.
October 7	29.849	°47.7	70.4 %	.50	S. W.	3-4	2,479	Cloudy	°60	°37
October 14	30.111	42.9	65.2	.60	N. W.	2-4	1,079	Cloudy	55	26
October 21	29.973	49.7	63	.06	S.	1-4	1,893	Clear	75	28
October 28	29.884	46.7	76.3	2.31	S.	4-4	1,951	Rain	69	32
November 4	29.983	54.3	71.2	.13	S. W.	3-4	1,769	Cloudy	75	37
November 11	29.987	40.3	78.5	1.00	S. W.	4-4	1,552	Cloudy	52	30
November 18	30.091	43.6	80.6	.71	N. E.	3-4	1,365	Cloudy	64	31
November 25	29.915	38.3	84.6	.26	S.	4-4	1,841	Cloudy	52	28
December 2	29.889	28.5	48.9	.77	S.W.	4-4	2,275	Snow	36	17
December 9	30.027	21.6	78.2	.31	S.W.	3-4	2,451	Cloudy	34	−5
December 16	29.968	27.1	75.1	.31	S.W.	3-4	2,748	Snow	45	−5
December 23	30.127	17.2	83.8	.26	S.W.	3-4	1,482	Cloudy	30	2
December 30	30.052	18.1	81.6	.97	S.W.	4-4	1,532	Snow	24	5
January 6, 1877	30.091	18.3	74.9	.14	S.W.	4-4	1.654	Cloudy	39	9

Note. The total velocity of wind for week ending October 14th includes three days only. Barometer corrected for temperature and elevation.

GEO. PRENDER, Sergeant Signal Service U. S. A.

Report of the Assistant Secretary.

To the Honorable Board of Police Commissioners of the City of Cleveland:

Gentlemen—I have the honor to herewith submit my Report for the fiscal year, ending December 31st, 1876, embracing the following general accounts:

Health Officer, Assistant Secretary, District Physicians, Sanitary Police, Small Pox Hospital, Swill and Garbage, Printing, Publishing and Stationery, Vaccine and Disinfectants, Postage, City Chemist, Miscellaneous.

Disbursements for the Year are as follows:

Health Officer and Assistant Secretary	$2,299 95	
District Physicians	3,355 01	
Sanitary Police	4,334 51	
		$9,989 47
Small Pox Hospital	2,318 81	
Swill and Garbage	2,040 00	
Printing, Publishing and Stationery	499 22	
Vaccine and Disinfectants	508 26	
City Chemist	361 00	
Miscellaneous	420 06	
Postage	31 23	
		6,178 58
		$16,168 05

Receipts for 1876.

Of J. J. Voght & Co	$14 69	
Of Fred. Hackendahl	400 00	
Of two loads Hay	20 67	
For amount overpaid on Rent of Office at Newburgh	6 25	
By Bills paid, as per vouchers, to balance	15,726 44	
		$16,168 05

On assuming charge of the office, April 15th, the following named officers and men were found on the pay-roll, and in active service:

DR. E. H. KELLEY, - - - - - Health Officer.
W. F. RUHTZ, - - - Secretary Board of Health.

Sanitary Police.

HUGH KELLEY, J. A. BARRETT, C. H. HALSEY,
JOSEPH AGRRICOLA, J. B. DWYRE, ANTHONY O'MALLEY.

District Physicians.

THOMAS HANNAN, A. J. GAWNE, M. L. OLDRYED,
P. B. JOICE, O. L. RYDER, JOSEPH SYKORA.

Small Pox Hospital.

GEORGE EWART, - - - - - - - - Steward.
NANCY EWART, - - - - - - - - - Matron.

On the organization of the present Board of Police Commissioners, the above named officers and men were dismissed, with the exception of the Steward and Matron of the Small Pox Hospital, who were retained in charge until September 1st, 1876.

The Board of Health having been abolished, the following officers were appointed to represent the Health Department under the new organization of the Board of Police:

FRANK WELLS, M. D., - - - - - Health Officer.
D. A. EDDY, - - - - - Assistant Secretary.

Sanitary Police.

JOHN BURLISON, A. VALLENDER, E. A. WEBB,
W. E. HEFFRON, P. G. COVERT, FRANK CLOBITZ,
JOHN VARNER, - - - - - Dismissed August 17th.
LUCIAN BARNEY, - - - - - Dismissed June 30th.

District Physicians.

H. H. POWELL, E. H. KELLEY, W. P. BRAINARD,
C. G. CLYNE, C. W. DELLENBAUGH, JOSEPH SYKORA.

Small Pox Hospital.

A. C. FULKERSON, - - - - - - - Steward.
MRS. A. C. FULKERSON, - - - - - Matron.

Who were dismissed by notice, November 1st, 1876, and gave up possession December 1st, 1876, to the present occupant now in charge, viz:

CHARLES KOHLMAN, - - - - - - Steward.
MRS. AMELIA KOHLMAN, - - - - - Matron.

TABLE VII.—*The Annual Report of Physician for District No. 1,*

For the Year ending December 31, 1876.

DISEASES.	Under 1 year.	Under 2 years.	Under 5 years.	Under 10 years.	Under 20 years.	Under 40 years.	Under 50 years.	Under 60 years.	Under 70 years.	Over 70 years.	Males.	Females.	Married.	Single.	Color.	Prescriptions, No. of	Visits Made, No. of	American.	German.	English.	Irish.	Jews.	Bohemians.	Negroes.	All others.	Total.
Zymotic	32	45	68	37	69	70	46	26	8	8	210	199	183	226	360	372	204	36	69	32	190	5	....	49	28	409
Constitutional	2	....	4	6	9	46	26	15	6	5	59	60	60	59	119	222	65	24	17	11	60	....	....	....	7	119
Local	14	8	22	28	37	144	97	85	27	15	169	308	223	254	477	434	119	41	81	39	285	5	1	....	25	477
Developmental	4	....	....	42	24	20	26	34	2	2	54	100	85	69	138	64	29	23	29	23	58	....	....	16	5	154
Violent	2	1	3	9	9	20	6	3	4	1	30	28	30	28	53	38	16	2	3	1	43	....	1	5	3	58
Total	54	54	97	122	148	300	201	163	47	31	522	695	581	636	1147	1130	433	126	199	106	636	10	2	70	68	1217

TABLE VIII.—*The Annual Report of Physician for District No. 2,*

For the Year ending December 31, 1876.

DISEASES.	Under 1 year.	Under 2 years.	Under 5 years.	Under 10 years.	Under 20 years.	Under 40 years.	Under 50 years.	Under 60 years.	Under 70 years.	Over 70 years.	Males.	Females.	Married.	Single.	Color.	Prescriptions, No. of	Visits Made, No. of	American.	German.	English.	Irish.	Jews.	Bohemians.	Negroes.	All others.	Total.
Zymotic	11	11	25	18	32	113	36	19	12	2	142	137	130	149	259	758	326	86	14	25	113	15	....	20	6	279
Constitutional	1	1	....	....	2	42	31	5	7	4	26	67	76	17	76	239	123	24	12	2	27	9	....	17	2	93
Local	7	8	15	20	60	189	100	43	21	20	182	301	323	160	424	1437	592	123	43	45	138	31	16	59	28	483
Developmental	3	....	....	....	3	15	....	4	5	4	9	25	22	12	32	80	40	17	1	2	9	3	....	2	....	34
Violent	....	....	1	2	5	23	10	....	10	....	29	22	32	19	47	129	58	5	7	2	24	3	1	4	6	51
Total	22	20	41	40	102	382	177	71	55	30	388	552	583	357	838	2643	1139	255	77	75	311	61	17	102	42	940

TABLE X.—*The Annual Report of Physician for District No. 3,*

For the Year ending December 31, 1876

DISEASES.	Under 1 year.	Under 2 years.	Under 5 years.	Under 10 years.	Under 20 years.	Under 40 years.	Under 50 years.	Under 60 years.	Under 70 years.	Over 70 years.	Males.	Females.	Married.	Single.	Color.	Prescriptions, No. of	Visits Made, No. of	American.	German.	English.	Irish.	Jews.	Bohemians.	Negroes.	All others.	Total.
Zymotic	9	32	86	70	51	68	35	9	9	1	186	165	131	221	351	355	525	21	30	9	282	....	4	....	5	351
Constitutional	....	....	....	2	32	39	31	13	5	2	56	68	74	50	124	194	72	22	24	9	67	1	....	....	1	124
Developmental	....	....	1	....	8	12	....	2	3	1	6	21	21	6	27	29	36	3	2	....	21	....	....	....	1	27
Local	....	11	43	78	81	105	147	83	49	19	6	316	286	241	361	602	766	508	25	70	22	478	....	2	....	5	602
Violent	....	1	4	6	4	13	6	7	....	3	31	13	26	18	44	36	27	....	6	1	36	....	....	....	1	44
Total	20	76	169	159	200	279	155	80	36	13	595	553	493	656	1148	1380	1168	71	132	41	884	1	6	....	13	1148

TABLE IX.—*The Annual Report of Physician for District No. 4,*

For the Year ending December 31, 1876.

DISEASES.	Under 1 year.	Under 2 years.	Under 5 years.	Under 10 years.	Under 20 years.	Under 40 years.	Under 50 years.	Under 60 years.	Under 70 years.	Over 70 years.	Males.	Females.	Married.	Single.	Color.	Prescriptions, No. of	Visits Made, No. of	American.	German.	English.	Irish.	Jews.	Bohemians.	Negroes.	All others.	Total.
Zymotic	6	3	14	8	10	21	12	4	....	....	42	36	29	49	78	267	218	31	14	3	10	....	10	....	1	78
Constitutional	....	1	....	....	1	17	7	2	....	....	14	14	15	13	28	91	65	4	7	1	11	....	4	....	1	28
Local	5	5	11	17	13	67	12	30	7	3	82	88	90	80	170	461	369	39	47	15	45	....	23	....	1	170
Developmental	1	....	....	....	....	2	....	....	....	....	....	3	....	3	3	10	8	1	2	....	....	....	....	....	....	3
Violent	....	....	....	1	4	5	2	1	....	2	9	6	6	9	15	66	47	3	5	1	1	....	5	....	....	15
Total	12	9	25	26	28	112	33	37	7	5	147	147	141	153	294	895	707	78	75	20	67	....	51	....	3	294

TABLE XI.—*The Annual Report of Physician for District No. 5,*

For the Year ending December 31, 1876.

DISEASES.	Under 1 year.	Under 2 years.	Under 5 years.	Under 10 years.	Under 20 years.	Under 40 years.	Under 50 years.	Under 60 years.	Under 70 years.	Over 70 years.	Males.	Females.	Married.	Single.	Color.	Prescriptions, No. of	Visits Made, No. of	American.	German.	English.	Irish.	Jews.	Bohemians.	Negroes.	All others.	Total.
Zymotic	7	3	12	11	4	16	6	1	....	....	35	25	18	42	60	202	199	42	7	2	4	....	4	....	1	60
Constitutional	....	....	....	....	5	8	8	7	1	....	8	21	24	5	29	79	63	9	9	5	6	....	....	....	....	29
Developmental	....	....	....	....	....	12	3	....	....	....	2	13	14	1	15	27	26	1	2	7	3	....	2	....	....	15
Local	7	6	6	12	7	61	35	10	....	1	61	84	87	58	140	362	323	65	28	10	18	....	17	5	2	145
Violent	....	....	....	....	1	....	1	....	....	....	1	1	1	1	2	3	3	1	1	....	....	....	....	....	....	2
Total	14	9	18	23	17	97	53	18	1	1	107	144	144	107	246	673	614	118	47	24	31	....	23	5	3	251

TABLE XII.—*The Annual Report of Physician for District No. 6,*

For the Year ending December 31, 1876.

DISEASES.	Under 1 year.	Under 2 years.	Under 5 years.	Under 10 years.	Under 20 years.	Under 40 years.	Under 50 years.	Under 60 years.	Under 70 years.	Over 70 years.	Males.	Females.	Married.	Single.	Color.	Prescriptions, No. of	Visits Made, No. of	American.	German.	English.	Irish.	Jews.	Bohemians.	Negroes.	All others.	Total.
Zymotic	4	14	16	6	8	8	8	2	2	....	38	30	28	40	68	154	114	....	8	4	30	....	26	....	....	68
Local	14	16	24	12	26	86	56	14	....	....	134	114	149	99	240	640	384	4	16	10	110	....	94	8	6	248
Constitutional	....	....	....	....	...	14	18	10	....	....	30	14	24	18	42	174	34	2	....	....	20	....	16	.. .	4	42
Developmental	....	....	....	....	....	5	7	3	1	....	7	9	12	4	16	50	11	....	3	....	7	....	6	....	....	16
Violent	....	....	....	2	2	12	....	2	....	....	16	2	14	4	18	38	8	....	2	....	8	....	8	....	....	18
Total	18	30	40	20	36	125	89	31	3	....	225	170	227	165	384	1056	551	6	29	14	175	....	150	8	10	392

TABLE XIII.—*Showing the Work of the Sanitary Police for the Year.*

WARDS.	Pig-Pens Cleaned.	Cow Stables Cleaned.	Loads Manure Removed.	Privy Vaults Cleaned.	New Vaults (Old ones Closed).	Vaults Repaired and Disinfected.	Yards Night Soil Removed.	New Privies Made.	Privies Repaired, Cleaned and Disinfected.	Yards Cleaned.	Alleys Cleaned.	Sewer Connections.	Dead Dogs Buried.	Dead Cats and Chickens Buried.	Slop Nuisances Abated.	Cellars Cleaned and Drained.	Street Nuisances Abated.	Cesspools Cleaned and Abated.	Houses, Rooms and Basements Cleaned and Disinfected.	Slaughter-Houses Cleaned.	Fat, Grease and Bone Works Suppressed.	Stock-Yards Cleaned and General Nuisances Abated.	Lots and Yards Graded. Old Buildings Removed.	Chicken-Coop Nuisances Abated.	Wells Cleaned and Closed.	Arrests.	Fines Imposed and Collected.
1st Ward	11	33	67	308	10	35	302	24	63	392	206	46	21	15	52	41	35	24	54	21	....	3	3	5	2	8	$17.80
2d Ward	2	6	133	120	2	2	158	1	24	244	49	11	18	38	19	32	33	12	12	.....	.....	5	2	...	2	7	11.20
3d Ward	6	5	112	91	7	8	118	2	27	217	52	12	17	44	18	26	30	6	11	.....	.....	2	4	....	3	.....	.....
4th Ward	7	32	74	133	21	26	210	15	56	236	141	14	24	25	49	37	56	29	33	.....	.....	1	2	6	1	5	22.20
5th Ward	8	19	17	71	19	16	110	4	11	149	54	9	22	19	63	8	43	9	8	6	3	4	5	....	5	1	16.00
6th Ward	1	7	39	46	4	3	120	2	5	74	36	..	7	6	16	3	11	9	2	2	....	3	.....	.....	3	1	1.40
7th Ward	5	13	58	79	26	32	36	10	20	140	52	3	15	25	61	16	41	7	8	4	1	2	2	2	9	2	80
8th Ward	....	4	9	19	3	....	156	..	5	11	7	..	8	5	4	....	4	.....	.....	4	....	5	6	3	..	1	1.40
9th Ward	....	4	9	19	3	....	106	..	5	11	7	..	8	5	4	....	4	.....	.....	4	....	4	2	2	..	.	.. ..
10th Ward	.....	4	9	19	3	....	62	..	5	11	7	.	8	5	4	....	4	.....	.....	5	....	6	3	.....			.....
11th Ward	27	19	70	92	27	16	64	5	18	103	66	3	11	27	57	11	65	13	17	9	....	3	1	.....	1		50
12th Ward	16	11	60	88	12	....	24	..	14	91	66	2	5	25	32	1	32	19	3	...	9	4	2	....	4	..	

TABLE XIII.—Continued.

Wards.	Pig-Pens Cleaned.	Cow Stables Cleaned.	Loads Manure Removed.	Privy Vaults Cleaned.	New Vaults (Old ones Closed).	Vaults Repaired and Disinfected.	Yards Night Soil Removed.	New Privies Made.	Privies Repaired, Cleaned and Disinfected.	Yards Cleaned.	Alleys Cleaned.	Sewer Connections.	Dead Dogs Buried.	Dead Cats and Chickens Buried.	Slop Nuisances Abated.	Cellars Cleaned and Drained.	Street Nuisances Abated.	Cesspools Cleaned and Abated.	Houses, Rooms and Basements Cleaned and Disinfected.	Slaughter-Houses Cleaned.	Fat, Grease and Bone Works Suppressed.	Stock Yards Cleaned and General Nuisances Abated.	Lots and Yards Graded. Old Buildings Removed.	Chicken Coop Nuisances Abated.	Wells Cleaned and Closed.	Arrests.	Fines Imposed and Collected.
13th Ward	14	8	9	46			32		15	48	14	2	6		11	10	11	6	2		2	2	1		7	
14th Ward	4	24	29	43	33	8	6	7	75	148	44		42	78	42	4	35	14	15	22					1	
15th Ward	3	9	51	36	7	10	24	2	17	67	42		14	19	26		16	7	12	9					2	
16th Ward				6			6			2													2			
17th and 18th Wards	3	10	52	31	47	2	24	5	22	72	22		23	23	13	7				7			4	2		
Total	107	208	798	*1584	224	158	1568	77	382	2016	865	102	246	359	473	202	420	155	177	83	15	44	39	21	39	26 $71.30

*337 of which were done by special contract and paid to Mr. Dart, the contractor.

Respectfully,

D. A. Eddy,

Assistant Secretary.

CONTENTS.

NATIONAL LIBRARY OF MEDICINE
U.S. Department of Health, Education, and Welfare, Public Health Service
Bethesda, Md.